SCIENTIFIC AMERICAN

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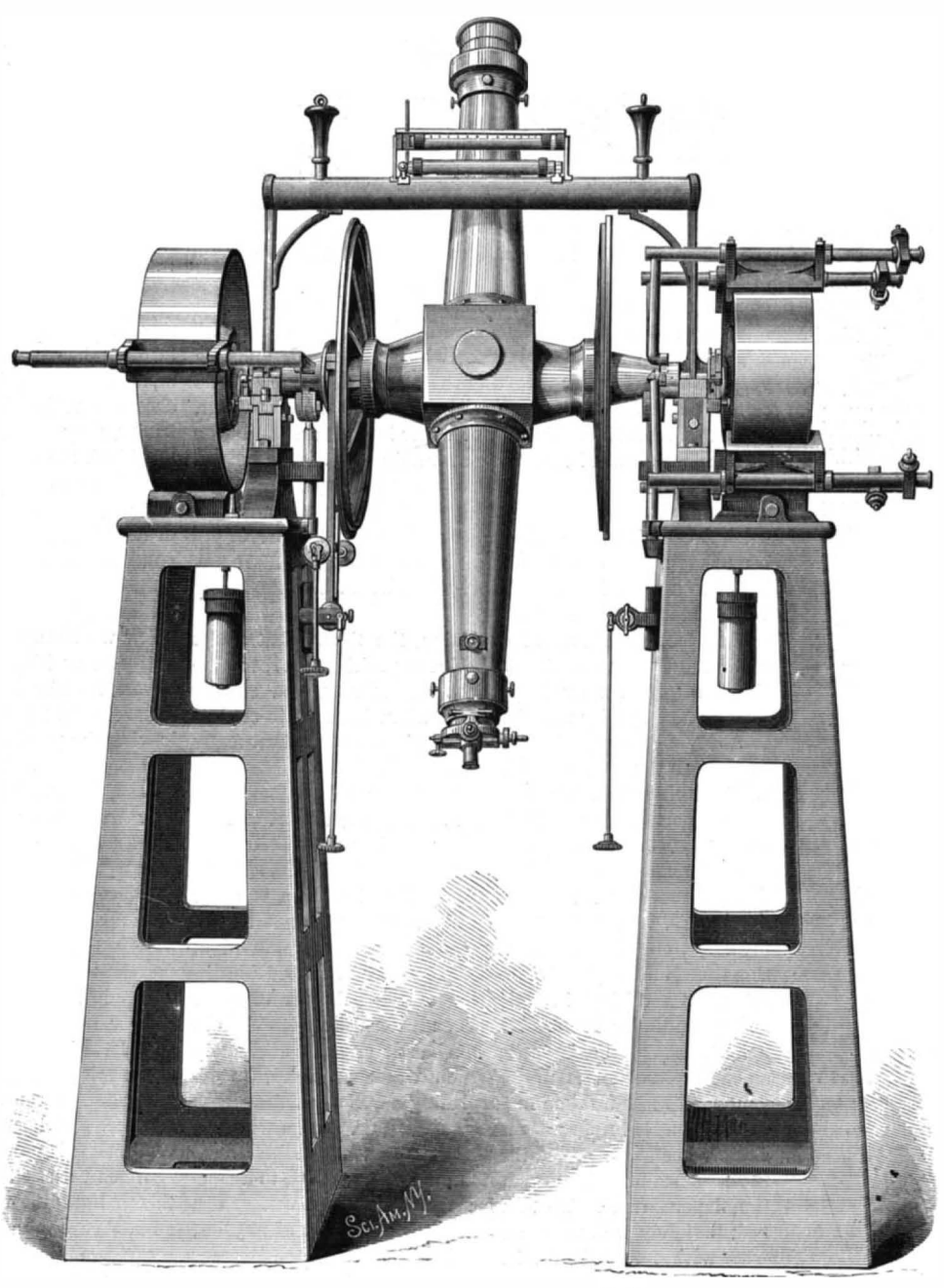
Vol. XLI.—No. 8. [NEW SERIES.] NEW YORK, AUGUST 23, 1879 [$3.20 per Annum. [POSTAGE PREPAID.]

NEW MERIDIAN CIRCLE.

Although telescopes of great size have for some time been manufactured in this country, all large observatory instruments of precision have heretofore been imported from Europe. Three years ago the firm of Fauth & Co., of Washington, D. C., was established and commenced the manufacture of large instruments of precision, and such was their success that they now stand in the front rank of their profession. Our engraving illustrates the large meridian circle made by this firm for Princeton College. A glance at it will show the instrument is very compact and solid; the convenience of the observer has been studiously considered, without interfering with the accuracy of the instrument.

The principal feature of this instrument lies, of course, in the accuracy of its graduated circles, which have a diameter of 25 inches. They are divided into 5 minute spaces, and are read off by means of four micrometer microscopes, which instead of being fixed to the pier, can be moved any desired angular distance. This is especially useful in examining the graduation. The instrument throughout has the latest improvements. Objective and eye-pieces can be interchanged; the bright field illumination can be changed instantly into the dark field with bright wires, the level, which indicates seconds of arc, can be read by means of a mirror. The piers upon which the telescope rests are cast hollow, in one piece, and the counterpoises are arranged within, as shown in the engraving. In use, however, the piers are covered with mahogany and lined with felt to prevent sudden changes of temperature affecting the instrument. For the purpose of reversing the telescope a reversing apparatus running on a railway is provided, which is not shown in cut, and it takes less than a minute to reverse the ponderous instrument, and it can be done with perfect ease.

We intend in coming issues to illustrate other instruments of precision made by the same firm. Messrs. Fauth & Co. manufacture all the instruments used by the United States Coast and Geodetic Survey. Among other matters of interest we expect to furnish our readers with a description of the graduating engine on which the circles of these instruments are divided with such marvelous accuracy.



FAUTH & CO.'S MERIDIAN CIRCLE.

To Attain Long Life.

He who strives after a long and pleasant term of life must seek to attain continual equanimity, and carefully to avoid everything which too violently taxes his feelings. Nothing more quickly consumes the vigor of life than the violence of the emotions of the mind. We know that anxiety and care can destroy the healthiest body; we know that fright and fear, yes, excess of joy, become deadly. They who are naturally cool and of a quiet turn of mind, upon whom nothing can make too powerful an impression, who are not wont to be excited either by great sorrow or great joy, have the best chance of living long and happy after their manner. Preserve, therefore, under all circumstances, counsels *The Sanitarian*, a composure of mind which no happiness, no misfortune, can too much disturb. Love nothing too violently; hate nothing too passionately; fear nothing too strongly.

American Institute Exhibition.

For forty-eight years the American Institute of New York has opened its doors and invited American inventors and manufacturers to exhibit their productions, and again this year it renews its invitation to all. To such as wish to reach the capitalist and consumer, they must admit that New York is the place. For details apply to the General Superintendent, by mail or otherwise.

Huxley on Industrial Education.

If a lad in an elementary school showed signs of special capacity, I would try to provide him with the means of continuing his education after his daily working life had begun. If in the evening classes he developed special capabilities in the direction of science or of drawing, I would try to secure him an apprenticeship to some trade in which those powers would have applicability. Or, if he chose to become a teacher, he should have the chance of so doing. Finally, to the lad of genius, the one in a million, I would make accessible the highest and most complete training the country could afford. Whatever that might cost, depend upon it the investment would be a good one. I weigh my words when I say that, if the nation could purchase a potential Watt or Davy or Faraday, at the cost of a hundred thousand pounds down, he would be dirt cheap at the money. It is a mere commonplace and every day piece of knowledge that what these three men did has produced untold millions of wealth in the narrowest economical sense of the word.—*The Sanitarian.*

Photographic Patterns.

One of the silk manufacturing firms of Lyons, France, are introducing the production of photographic impressions on stuffs. They sent to a recent meeting of the Photographic Society several pieces of silk with a variety of photographic pictures printed thereon, including, among others, a number of large medallions representing pictures of the old masters. The length of the specimens thus exhibited is stated as being no less than 131 feet. The process by which they are produced is not given, but it is believed, says the *Commercial Bulletin*, that the prints are made with salts of silver.

Dephosphorizing Pig Iron—Utilization of Phosphorus.

Professor Wedding, in a paper contributed to a German publication, gives some data on the practical working of Krupp's, or rather Narjes', process for dephosphorizing pig iron. The originator of the process is Mr. Narjes, an engineer connected with Herr Krupp's works at Essen, who, on the 16th and 17th of March, 1877, worked the first heat on a large scale, four tons of pig, holding 0·7 per cent of phosphorus, being reduced to metal running 0·134 per cent, while the percentage of carbon sank only from 3·10 to 3·03 per cent. A patent was applied for and granted on the 2d of July, while Bell's provisional specification was drawn up on the 11th of April.

Narjes' process consists in dephosphorizing and refining the pig without affecting the carbon percentage materially, by oxides of iron and manganese partly used as fettling and partly by additions. The practice at Essen is said to be simple; the pig is melted in a 18 foot cupola with coke in one hour and a half, and then tapped into a furnace similar to the Pernot, heated by the regenerative system. The flat hearth is covered with a layer of almost one foot of iron melted at a very high temperature. Before every heat from 1,500 to 1,700 lb. of ore, also heated until sintered, are added. Another point which has not yet been settled is whether it will be possible, by adding a silicious pig, to fit the refined metal for the Bessemer process, for which, as at present constituted, it is not suitable, as the dephosphorizing process eliminates the silicon simultaneously.

Apropos to the above, the Boston *Journal of Commerce* adds that Mr. Sidney G. Thomas, one of the inventors of another famous dephosphorizing process, not content with having rendered phosphorus—that dreaded impurity of iron and steel—harmless, has gone one step further, and proposes the utilization of the phosphorus which in his process is, as it were, concentrated in the slag. He roasts the cinder obtained in blowing pig with simultaneous additions of lime and oxide of iron, in a reverberatory furnace, in order to convert the protoxides of iron and manganese into insoluble peroxides. After calcination the slag is ground fine, and is treated with cold hydrochloric or sulphuric acid, diluted, or with a cold solution of sulphurous acid, which dissolves the phosphoric acid. With the latter solvent the phosphate will be almost at once precipitated on heating, while the sulphurous acid, which is driven off, may be recovered by condensation. The solution in hydrochloric or sulphuric acid may be completely evaporated, forming a concentrated product which, when the former acid has been used, contains chloride of lime. These, or any other methods practiced for the manufacture of phosphates, may be made use of. As few have an idea of the enormous quantities of phosphorus which are annually wasted in the manufacture of iron, it may be interesting to cite the fact that the phosphorus contained in the iron produced in the Cleveland district of England alone amounts to 30,000 tons. The recovery of phosphorus is not a novel idea, but it is possible that the concentration of phosphoric acid in the slag (7 to 15 per cent) may render it practically attainable.

Carbon Photo Printing.

Mr. F. Gutekunst, 712 Arch street, Philadelphia, has organized a complete establishment for the printing of photographs by the carbon process, that is, in printer's ink that never fades. We have received some specimens of the work done, which are unsurpassed for excellence and reflect credit on the printer. For book illustration and portraiture this method of printing yields the finest results.

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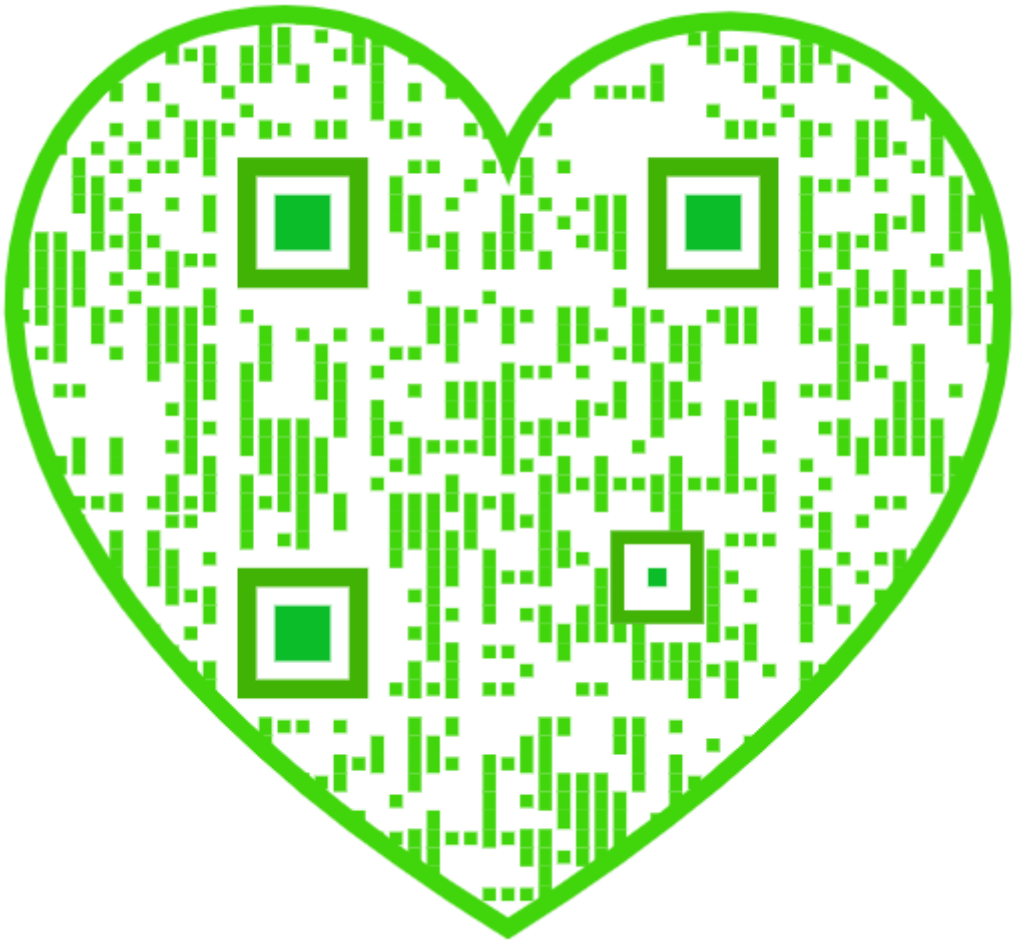

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VOL. XLI., No. 8. [NEW SERIES.] *Thirty-fifth Year.*

NEW YORK, SATURDAY, AUGUST 23, 1879.

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Minot's Ledge Lighthouse. By J. G. BARNARD, U. S. A., 1 illustration showing elevation, section, foundation stones and plans of 1st, 2d, and 3d courses; also comparative sections of Eddystone, Inch Cape, Wolf Rock, and Skerryvore lighthouses.

Gas Engines. Construction, economy, and advantages of gas engines. Latest improved gas engines. Fig. 1, side view of sixteen horse Otto Silent gas engine. Fig. 2, end view of same. Fig. 3, section Clerk's gas engine.

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How to Adjust Line shafting. By JOSHUA ROSE, 5 figures.

Millstone Dress and Dressing Tools. Fig. 1. Twenty-one varieties of dressing for buhrs. Fig. 2. Nine varieties for iron plates. Figs. 3 and 4. Machines for dressing millstones. Figs. 5, 6, 7, and 8. Various millstone hammers and picks.

Scientific Notes. Methods proposed for raising the iron clad Vanguard, 3 figures.

A Home Made Horse Power. By WILLIAM ROBT. BROOKS, 2 figures. A cheap, practical, serviceable device which any farmer can put up.

Lowell: Life and Labor in a New England Factory City. Statistics of wages and living. What improved machinery has done. Mill spinning. Condition of our factory operatives. Average earnings. Foreign population. What Charles Dickens said of Lowell. A striking contrast. English vs. American life conditions.

II. TECHNOLOGY AND CHEMISTRY.—The Preparation of Cottonseed Oil.

White Bricks from Red Clays. Gelatino-Bromide Plates. By A. J. JARMAN. A method by which plates can be prepared at home, surely and easily.

Reasons for Preferring Dry Plates to Wet Collodion. A cogent review of the advantages of the dry process, by a practical photographer.

Coloring Matter of Santal and Callistura Wood. By N. FRANCHIMONT.

III. MEDICINE AND HYGIENE.—Southern California as a Health Resort.

Yellow Fever. By ALFRED STILLE, M.D., LL.D. Earliest account of yellow fever. Its origin. Transatlantic epidemics. The disease has never originated outside of the West Indies Conditions under which yellow fever is generated. Limited local origin of yellow fever established. Efficacy of rigid quarantine. Circumstances influencing the diffusion and fatality of yellow fever. Comparative immunity of the colored race. Essential cause of yellow fever unknown. Theory of germ origin not proved. Death not caused by uræmia. Proofs of its non-contagiousness. Is an infectious disease. Rapidity of the diffusion of yellow fever poison. Effects of low temperature. Pathology of yellow fever. Explanation of black vomit. The liver in yellow fever. Forms of yellow fever. Symptoms of inflammatory yellow fever. Malignant type of the disease. Prognosis of yellow fever. Diognosis. Treatment. No known specific for yellow fever.

A Peculiar Form of Mania.

The Identity of Tuberculous Corpuscles and Decolorized Blood Corpuscles. Evidence of the alleged identity. Communicated by ROLLIN R GREGG, M.D.

IV. BIOLOGY.—The Beginnings of Life. III. By Prof. EDMOND PERRIER. (Continued from SUPPLEMENT No. 189). Beings intermediate between animals and plants. Fig. 1. Zoospores and antherozoids of cryptograms. Fig. 2. Algæ of the family of volvoxineæ. Fig. 3. Magosphæra planula. Fig. 4. Myxomycites.

Anthropometrical measurements. Physical comparisons of nineteen different peoples.

V. ETHNOLOGY AND GEOLOGY.—The Wisconsin Pictured Cave. Report of Rev. EDWIN BROWN, to the Wisconsin Historical Society.

Note on the Discovery of a Human Skull in the Drift, near Denver, Colorado. By THOMAS BELT.

The Geological Museum of the School of Mines, Columbia College. By ISRAEL C. RUSSELL. A remarkably full and able account of one of the most important scientific collections in this country.

VI. ELECTRICITY AND MAGNETISM.—Deprez's Electro-Magnetic Engine. By COUNT DU MONCEL. A wonderful little motor.

A SUBJECT FOR INVESTIGATION.

In another column we reprint a remarkably suggestive article from the London *Engineer* on the mysterious in boiler explosions.

In spite of conviction of the great majority of boiler inspectors, that boilers explode from inherent defects, weakness, or gross misusage, our learned and practical contemporary deems it beyond question that there is yet an element of mystery attending some of the catastrophes of the sort. While ninety-nine in every hundred explosions may be clearly traceable to faults in material or construction, defects due to age or abuse, ignorance, carelessness, or neglect in management, or some other preventable cause, the *Engineer* believes, and is not alone in believing, that in the hundredth case the boiler may suddenly fly to pieces in the absence of all known conditions tending thereto.

The strength or weakness of this position hinges on the circumstance that when a new and strong boiler explodes "mysteriously" it is rarely possible to determine what the immediately antecedent conditions were. The engineer in attendance is usually killed; and there is no means of telling exactly what was the condition of the boiler, or what was going on in it, the moment before the explosion occurred. The recklessness, ignorance, or misconduct of the engineer may have brought about the disaster; but it is not safe to assume his fault in all cases, as the only alternative to indeterminable conditions.

In the Coltness case referred to, for example, "when six boilers out of ten flew away at once like a covey of birds," the boilers are described as strong enough to stand a pressure of 300 pounds, and it is not easy to see how such a pressure of steam could have been produced through any fault of the engineer or otherwise.

In a recent attempt to explain why boilers explode a Philadelphia paper says:

"If we could get down to the bottom facts of every boiler explosion it would probably be found, in nine cases out of ten, that the engineer in charge had permitted the water to get below the flues, and that, upon ascertaining the fact, he had, in his fright, turned cold water in upon the hot iron. No boiler that was ever made can withstand the tremendous pressure applied by the sudden conversion of a large volume of water into steam, and the reason why it cannot may easily be comprehended when it is remembered that one cubic foot of water will make seventeen hundred cubic feet of steam."

This theory is, and has been, widely accepted; and is a very plausible one for throwing the blame on the dead, who cannot contradict the charge. The circumstance, however, that to convert the cubic foot of water into steam would use up the spare heat of something over a quarter of a ton of red hot iron, makes the sudden conversion of a large volume of water into steam, in any ordinary boiler, altogether doubtful. As the *Engineer* pertinently remarks, it has never yet been shown how enough red hot iron could be present in any boiler to cause a development of steam with which the safety valves could not deal.

The electrical theory of explosion, the theory that under certain unknown conditions the decomposition and recomposition of water may take place explosively, and similar guesses, are equally unsatisfactory when brought to critical test of fact and experiments. The circumstance that many explosions take place just when an engine is started suggests the possibility that the sudden reduction of pressure may cause a part of the water to flash into steam; and it is supposed that somehow, by some physical law not yet discovered, the flashing process may be self-continuing in spite of the restoration of the pressure. This, however, is sheer hypothesis, and involves conditions as mysterious as the mystery to be explained. And after all, what is wanted at this time is not a plausible explanation of an unavoidable disaster, but a critical investigation of the behavior of water and steam under all conceivable conditions likely to obtain in boilers. As soon as investigation has determined absolutely all the circumstances under which water explodes, the inventor will lose no time in furnishing a boiler which will not explode under intelligent management. Thanks to what has already been determined the range of mystery in boiler explosions has been narrowed, numerically speaking, to a fractional percentage. To remove the remaining mystery is a task that may well engage any ambitious student of physics, who wishes to gain an honorable fame by benefiting his kind.

STILLÉ ON YELLOW FEVER.

At this time, when public attention is so forcibly drawn to the plague that prevails at Memphis and Havana, and threatens every commercial city of the country, our readers cannot fail to be interested in the critical review of the natural and clinical history of yellow fever, by Dr. Alfred Stillé, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

There is probably no man living whose competence to discuss the subject is more widely recognized; and now that the newspapers are so full of speculation and error in respect to the origin and propagation of the disease, the profession as well as the public will be glad to know from him what he holds to be positively known about it.

Dr. Stillé traces the origin of yellow fever to the West Indies. There it was first discovered; and from West India ports it has, in all instances, spread. It has never originated elsewhere, however favorable the conditions may have been for its rapid extension when once introduced. A high temperature is essential to its propagation; salt water and unsanitary conditions favor it; but the morbid poison must be imported in ships and fomites. A strict quarantine is always efficient in preventing the dissemination of the disease. It is not contagious. Its essential cause has never been isolated or defined, but is assumed to be a specific poison, distinct from all other fever poisons. It is spread by infection. In the system it acts primarily in two ways: by disintegrating the blood and by inflaming the stomach; secondarily, it tends to impair the eliminating function of the kidneys.

The evidence upon which these conclusions are founded, with much exact and timely information as to the character and behavior of the disease, and the effects of different modes of treatment, will be found in Dr. Stillé's lecture, reported specially for the SUPPLEMENT.

A NEW METHOD OF LOCATING LIGHTNING RODS.

The Brockton (Mass.) *Weekly Gazette* contains a long account of a so-called wonderful discovery which has been made by Messrs. George S. and A. R. Prescott, of Merrimac, Mass. These gentlemen have ascertained that "lightning never strikes the earth except in localities directly over what may perhaps be best described as electrical currents on or below its surface, with which currents the electrical discharge invariably communicates. This has been determined by a multitude of tests made in localities widely separated. It follows, therefore, that in places where these currents are not found to exist, no danger need be apprehended, as in upward of four thousand instances, where tests have been made during the past three years, no record can be found of any exception to this universal rule."

This is certainly a wonderful discovery and merits careful attention. The subject is in the domain of science, and it can be reasonably presumed that the Messrs. Prescott have some knowledge of electricity, especially of earth currents, since their work is claimed to be in the detection of such currents. Moreover, these gentlemen must have made use of scientific methods, which past experience has shown to be indispensable, or they must have created a new method which rests on a scientific basis and is not dependent upon the freaks of the observer.

On careful inquiry we have ascertained that the Messrs. Prescott lay no claim to a knowledge of science. They are farmers, and have gained their knowledge of agricultural operations from actual practice in this pursuit, and not from mere theories. Whatever success they have obtained in farming has been due to the experience which has been handed down to them and by a lifetime of labor in their chosen pursuit Without any knowledge whatever of electricity, they have suddenly made a discovery which puts to the blush the labors of scientific men in meteorology; have curbed, so to speak, the thunderbolts of Jove; have within their reach an immense fortune; and, more than all, have demonstrated that honest ignorance can discover what skilled education has overlooked. Their method also has never been employed or even thought of by scientific men. We shall first describe it in practical operation, and then devote a few words to its theory. Having cut a forked stick from a tree—any kind of wood will answer, although the discoverers prefer a forked stick from an apple tree, an elm, or a hazel—the two forks are grasped firmly with both hands, leaving the portion above the fork projecting skyward and not earthward. With the stick held in this manner, and with a look which may be described as sublunar, the operator walks over the ground to and fro, here a little and there a little, until he perceives that the projecting part of the stick begins to point downward. Then he stops and announces that there is an earth current beneath him. He does not know what an earth current is, nor how it usually manifests itself, nor what tests are usually employed, nor does he need to know, for the green apple tree stick decides the point. He must not, however, wear rubber boots; leather boots are preferable. In this way four thousand tests have been made and repeated; sometimes with a green apple stick, sometimes with an elm stick. Changing the character of the stick, however, appeared to make no difference. Further experiments, however, are needed to clearly establish this point.

When the stick points to the ground it is clear evidence that a lightning rod must be led to this point. If no earth currents are found by this method, the house in this locality is pronounced to be safe, and does not need lightning rods. The Messrs. Prescott form a marked exception to the old adage that "a prophet is not without honor save in his own country and among his own kindred," for no other "lightning rod man" is employed in the neighborhood of their native town, Merrimac, and their fame has spread far and wide. Treasurers and presidents of banks, city engineers, teachers in academies and schools, proclaim that, however impossible it may seem, they have been witnesses to the Messrs. Prescott's skill—perhaps we should say to Mr. Prescott's skill, for one of the brothers excels the other in this matter—and no amount of scientific skepticism can change their faith in Mr. Prescott's discovery. Hundreds of people are ready to testify to the fact that Mr. Prescott has repeatedly discovered places where lightning has struck in the past; and on being led by the oldest inhabitant into places remote from the Prescott homestead, has infallibly proclaimed to the awestruck observers, "Lightning once struck within four feet or less of this point." So much for the practice. Now for the theory.

It is claimed that "the human frame is the most sensitive to electrical influences of any organized form. Indeed, so far as cognizant to the sense and present knowledge, elec

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tricity seems to be the factor of the mysterious principle of life in the work of the human system." Mr. Prescott has a wonderfully sensitive organization. He has the hitherto unknown "electric sense," and he can, to speak metaphorically, smell electricity or taste it in the air or earth. He is not, however, the only person who has claimed to have this power. If he and his friends will procure a copy of Baron Charles von Reichenbach's "Physico-Physiological Researches in the Dynamics of Magnetism, Electricity, Crystallization, and Chemism," published in Partridge & Brittain's Spiritual Library, it will be found that Mr. Prescott belongs to the class called sick sensitives; in other words, to a class of persons whose systems are supposed to be peculiarly sensitive from disease to general cosmical phenomena. In the same book will also be found a long account of the use of a forked stick, which use is there called Blétonism, from the name of an agricultural laborer who had great success in its use. It is evident that agriculture is about to assert itself in the cognate field of electricity and magnetism. An account of the forked stick can also be found in Dr. Hutton's Mathematical Recreations, which is a translation with additions of Montucla's improvement of Ozanam's Recreations. An account of the virtues of the forked stick can also be found in Dr. Herbert Mayo's "On the Truths contained in Popular Superstitions" Letter XII. (London, 3d ed., 1851). It may interest Mr. Prescott to know that his forked stick has various names. It has been called divining rod, virgula divina, baculus divinatorious, baquette divinatoire, and the wonders accomplished by its use have been testified to by thousands of people for more than a century. If Mr. Prescott is a reader of fiction, he will also find an account of Bouster Swivel's use of the forked stick in Walter Scott's novel "The Antiquary."

It is said by Mr. Prescott's believers that if he did not use such an absurdly simple contrivance as a forked stick he would have more followers and make a greater fortune. Indeed, it has been proposed that he should get up a complicated contrivance with a maze of wheels and electro-magnets, which should have nothing, however, to do with his method; but walking forth in boots (leather), with the stick and the machine, he should attribute the discoveries to the machine. Pessimists claim that he would then be in entire sympathy with the age.

Briefly let us sum up the claims of the Prescotts. We shall put the claims against the evidence in the following table:

CLAIMS.	EVIDENCE.
A forked stick in the hands of a sensitive person is a scientific instrument capable of detecting earth currents.	No evidence has ever been submitted to men capable of judgment on this point. The belief is supported only by invalids, and is an evidence of invalidism.
Mr. Prescott belongs to the class called "sick sensitives."	No medical school of any standing believes in the powers of the "sick sensitives" to discover occult phenomena. No master of his profession believes in such powers.
Earth currents have a determinate direction, and under the action of thunderstorms will always take the same direction.	Earth currents do not have a determinate direction, and the influence of a thunderstorm does not determine their direction.
The electric discharge seeks to unite itself with earth currents.	No evidence. This can only be determined by electrical tests, which Mr. Prescott and his friends are incapable of making, from utter ignorance of the subject of electricity.

The above is our statement of the case, and it is only justice to Mr. Prescott and his followers to state his case in the same manner, with a few comments, which can be taken or rejected.

CLAIMS.	EVIDENCE.
Four thousand test cases, more or less.	Tests made of twigs from three or more kinds of trees, all taken from different localities, and cut by unprejudiced observers.
The testimony of innumerable people, including teachers in high schools, civil engineers, and prominent business men of high standing and respectability. They have seen with their own eyes. They have been convinced beyond all doubt.	Respectability has always had great weight in deciding upon scientific matters. It is reasonable to suppose that if a bank president or cashier maintains his good standing in the community, his judgment on any subject, even on one to which he has paid no attention, is of value. Civil engineers and teachers can be summoned as experts in matters of scientific evidence.
Mr. Prescott has eminently the air of an honest man. He has been known man and boy by his neighbors for many years.	Honest looking men have never deluded themselves or deluded their neighbors.

In conclusion, the use of the forked stick is recommended to mining speculators and prospectors. Thousands of respectable persons in the past have testified to its efficiency in discovering lodes of precious metals, and it is one of the strangest facts in human history that mankind has stubbornly refused to discover precious metals by the use of such a simple means, and have forced themselves into what may be called complicated and theoretical scientific methods.

LABOR AT HOME AND ABROAD.

The reports of American Consuls in Europe, with respect to the conditions of trade in their several districts, have in many instances been laid before the readers of this paper. It will be no news to them, accordingly, to be told that the average condition of industrial communities abroad is far below that which has obtained here, even in the worst of times. The effect of these reports is naturally intensified when they are massed together, with the evidence on which they were based, as they have been in a volume just issued by the Department of State. Covering, as they do, all phases of the labor question in Europe, these reports furnish a telling picture of the condition of the working people of Europe—their continued struggle with adverse circumstances—as compared with the condition of the working people of the United States, and show, as perhaps no single volume has ever done before, the difference between labor disfranchised, degraded, and hopeless, and labor free, honorable, thriving, and an equal sharer in political power.

The following deductions are said by the department to be clearly proved by the reports:

1. That wages in the United States are double those of Belgium, Denmark, France, and England, three times those of Germany, Italy, and Spain, and four times those of the Netherlands.

2. That the prices of the necessaries of life are lower in the United States than in Europe, and that the laborer in the United States, were he satisfied with the scanty and miserable fare upon which the European laborer must live, can purchase like food for less money than it can be purchased for in Europe.

3. That the French working people, with far less wages, are happier than the working people of Great Britain, who receive the highest wages in Europe, on account of the steadiness and the economical habits of the former, and the strikes, drinking habits, and consequent recklessness of the latter.

4. That more misery results from strikes, drinking, socialism, and communism in England and Germany than from all other causes combined, hard times included.

DRAGON FLIES.

"Dragon flies," "mosquito hawks," "devil's darning needles"—these are some of the common names for certain well known neuropterous insects of the family *Libellulidæ*. They are commonly seen skimming in swift flight over the surfaces of ponds and other bodies of still water. The head and thorax are greatly enlarged—the eyes entirely covering the sides of the former—and the hind body is very long and slender, terminating in the male with a pair of clasps for seizing the female. The two pairs of wings are nearly equal in size, transparent, and finely netted, and in many species clouded with broad bands of brown, blue, or crimson. The flies attach their eggs to the submerged leaves of aquatic plants or drop them carelessly upon the surface of the water.

The larvæ are aquatic, living at the bottom of the pool or stream they inhabit, and breathing by means of *tracheæ* situated in the tail. They are further characterized by what is known as a "mask," which is an elbowed extension of the *labium* or under lip, and is armed at the extremity with two sharp hooks for seizing and holding the prey. When not in use this apparatus is folded up over the lower part of the face, but to grasp a victim may be suddenly thrust forward, These dragon fly larvæ feed upon young mosquitoes or "wrigglers" and other aquatic insects, particularly the young of May flies (*Ephemeridæ*. They are active and pre dacious in the pupa as well as in the larva and perfect states. When about to change into a fly the pupa leaves the water and crawls upon some plant or other object above the surface of the water. After clinging there a short time a rent appears on the top of the thorax, through which the fly emerges.—*Prof. C. V. Riley.*

Louis Favre.

The news of the death of Mr. Louis Favre, the contractor of the Great Tunnel of the St. Gothard, spread through the city of Geneva on Saturday, July 19, calling forth, says the *Swiss Times*, universal expression of sympathy and regret. Louis Favre was a man of more than ordinary merit. He commenced life as a day laborer and won his way up to the front rank by sheer force of will and honest industry. This name will be handed down to posterity in connection with the great enterprise of his life, and his descendants may speak of him with more pride as Favre du Gothard than if he had been born to one of the thousand titles to a *de* or a *von*. At the time of his death he had overcome the great obstacles to the success of his gigantic undertaking, and it is no secret that these obstacles came rather from men than from nature. He falls, as fell Sommelier of the Mont Cenis, after years of persistent and weary warfare at the moment when his labors were to be crowned with honor, riches, and the calm enjoyment of a world-wide reputation which all men love so well.

To those who had the good fortune to meet him in his great natural workshop, the bowels of the St. Gothard, he leaves a remembrance of a lion hearted man, endowed with all the charm which comes from strong will tempered by rich experience and a buoyancy of spirits which nothing could repress.

THE AMERICAN ONION-SMUT IN FRANCE.

According to M. Max. Cornu, in a note recently presented to the French Academy, the onions are being attacked in the vicinity of Paris by a fungus which fills the interior of the bulb-scales and the base of the leaves with a black powder. A longitudinal section of the bulbs attacked (which belong to the early variety of the white onion and the onion of Nancy) shows that the black dust occupies the entire substance of the scales or of the leaves. The presence of the parasite, in addition to the decay which it produces, greatly modifies and alters the normally white appearance of the onions. The black dust, examined with the microscope, is seen to be composed solely of an enormous quantity of spores; and these spores are characteristic of a genus of ustilagineæ, which was first called polycystis by Leveillé, and afterwards urocystis by Robenhorst.

The particular species under consideration is new, not only to France, but to Europe, and is not mentioned in the works of Tulasne. Dr. Farlow, of Harvard College, in his report on the diseases of onions, first called attention to it, and described it as new under the name of urocystis cepulæ. It is only in recent years that the fungus has made its appearance in America, its ravages for a dozen years past having been confined to the States of Connecticut and Massachusetts, where the culture of onions forms an important branch of agriculture. Here it has produced a damage amounting to many thousands of dollars a year. At the date of Dr. Farlow's report the disease was as yet unknown in New York. Dr. Farlow thinks that the fungus has come from some of our wild species of onions. Mixing the seeds with lime or special treatments of the soil have no effect, and it appears that it is necessary to wait four years before commencing onion culture in the same soil again. "It is not the first time," says M. Cornu, "that a new infection has come to us from America. Without citing the phylloxera and dorysphora, insects equally to be feared, I may mention the oidium of the vine, and puccinia malvacearum, the latter of which I first noticed the presence of in Europe."

We are willing to father the potato-bug, the phylloxera, and, perhaps, the onion-smut, since it was first detected here; but the so-called "oidium" of the vine occurs here, not on native vines, but on those of European species raised in hothouses. As for the mallows-brand (puccinia malvacearum), no American mycologist has as yet reported its presence among us; we have seen specimens from Africa, however.

NORDENSKJOLD'S EXPEDITION.

The fact was announced not long since that Professor Nordenskjold's expedition had survived the winter, ice bound near East Cape, Siberia, and that the explorer hoped soon to be able to proceed to Behring Strait, about 400 geographical miles from the Vega's winter quarters. Dispatches from Stockholm and Berlin, August 3 and 4, state that the Vega had got clear of ice and passed the strait; but no information is given of the route through which the alleged intelligence came. On the other hand, the Alaska Fur Company at San Francisco strongly doubt the truth of the report. Their advices from the neighborhood of Behring Strait were to the effect that the season had been very late on the Asiatic side, and that strong east winds had prevailed, piling up the ice so as to make the possible passage of the Vega very doubtful.

Activity in the Iron Trade.

Though it is now midsummer, usually a dull season in the iron trade, the demand for iron is great and prices are tending upward. The intelligent secretary of the Iron and Steel Association of the United States predicts that the product this year will be the largest the country has known. He also believes that the activity which prevails to-day in all branches of the iron and steel trade will continue for at least a year to come. Nearly all the favorably situated rolling mills are in operation, and numbers of these mills, as well as furnaces and steel works, have orders ahead for several months. The truth is the iron industry has been so long under a cloud that the actual need of iron throughout the country is enormous.

MANY persons are puzzled to understand what the terms "fourpenny," "sixpenny," and "tenpenny" mean as applied to nails. "Fourpenny" means four pounds to the thousand nails, or "sixpenny" means six pounds to the thousand, and so on. It is an old English term, and meant at first "ten pound" nails (the thousand being understood), but the old English clipped it to "tenpun," and from that it degenerated until "penny" was substituted for "pounds." When a thousand nails weigh less than one pound they are called tacks, brads, etc., and are reckoned by ounces.

The Paper Makers' Association.

The second annual convention of the Paper Makers' Association of America assembled at the Grand Union Hotel, Saratoga, N. Y., July 30 About forty manufacturers were present. Wellington Smith, of Lee, Mass., presided. He said that although prices were lower than last year the trade was in a better condition, there being an increased demand; that a year ago the trade was in the lowest condition ever known, but now the mills throughout the country were running on full time.

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THE HOLLY SYSTEM OF STEAM HEATING.

These are the days of large enterprises, when things are done by wholesale, by a massing of labor and a concentration of capital. Many of our daily wants are supplied not by the simple, single-handed ways of our forefathers, but by a system of supply which economizes labor and lessens expense. Our light comes to us through pipes in the streets; the water used by the thousands of families in any of our large cities comes from a single source of supply; many of our other needs are supplied in a similar way; and now, at last, our dwellings and places of business, our churches and public buildings, are to be heated from a common center.

We have on one or two former occasions alluded to the Holly system of steam heating, controlled by the Holly Steam Combination Company, of Lockport, N. Y., and now we are able to present our readers with engravings representing some of the details of the system. Heating by steam has been practiced for years; but it has been accomplished by placing the steam generator as near the radiators as possible. This has demonstrated the desirability of steam as a heating agent, and at the same time has proved its hygienic and economic superiority over other methods of heating. The Holly system goes a step further and increases the measure of economy and safety, and decreases the labor connected with steam heating by generating the steam at a central station, and supplying a large area with steam for heating, for cooking, and for power, through underground pipes, thoroughly protected against radiation, and provided with expansion joints, steam meters, pressure regulators, and other apparatus necessary to the perfect working of the system.

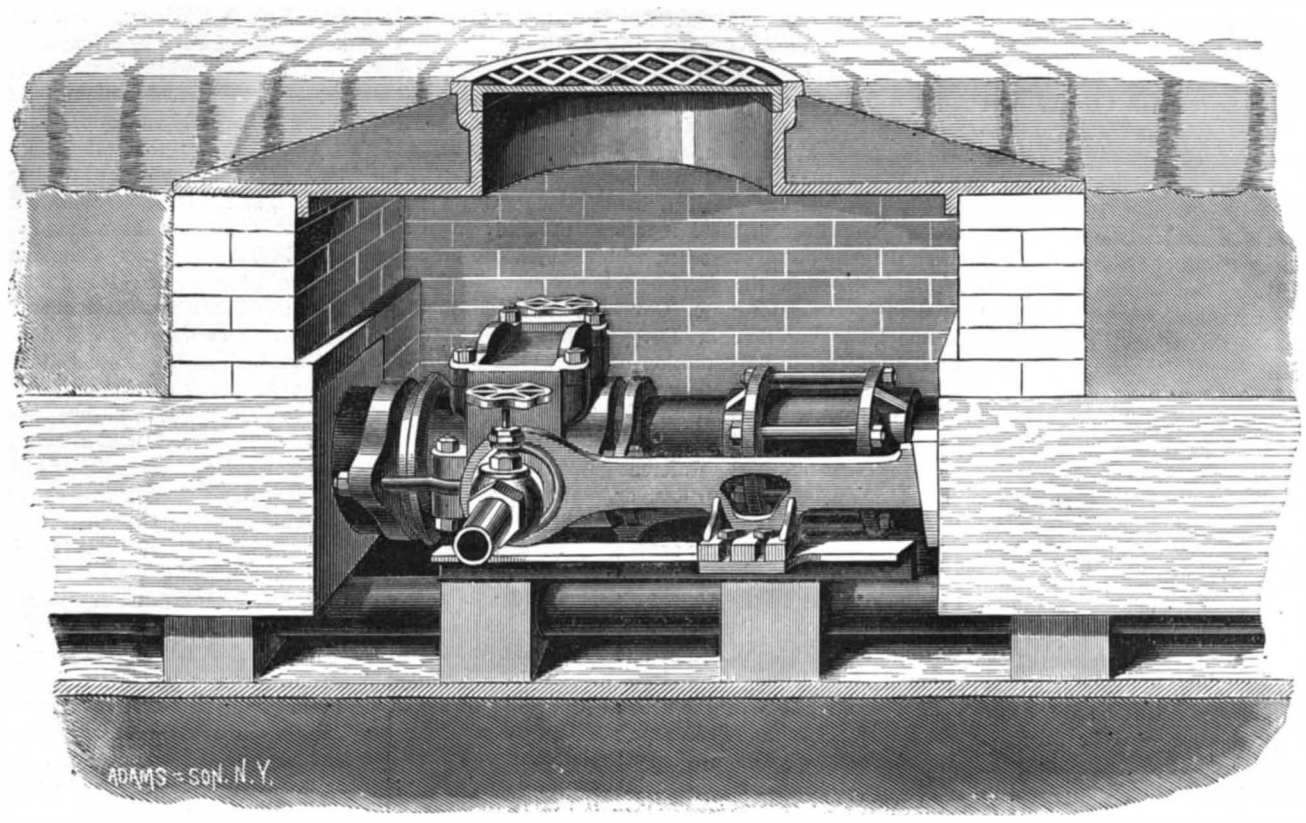

Fig. 1.—EXPANSION SERVICE BOX.

The first experiment on a grand scale was tried in January, 1877, in the city of Lockport. Three miles of underground pipe were employed to thoroughly test the feasibility of the project. It proved a complete success, and the company is now engaged in introducing the system into several of the larger cities in this country.

In the pipes used in this system, an expansion junction service box, Fig. 1, is placed at intervals of 100 to 200 feet. This provides for the free longitudinal expansion and contraction of the mains, and from this box the service pipes are carried underground to the basement of buildings to be heated. The service pipes, having an adjustable hood inside the junction box, may be turned downward, thus taking up the water of condensation as fast as it accumulates, and carrying it forward to the regulator valve inside the cellar walls, as shown in Fig. 2. At this point, the water of condensation being at the degree of heat due to 50 lb. pressure to the square inch, is wire drawn, and by this reduction of pressure it is largely reconverted into steam, and is carried on to the radiators, where it is again condensed. By this device it will be seen that although 50 lb. pressure is carried in the mains, it may be reduced to one or two pounds in the building, and therefore in a house two or three miles distant from the boiler there will be precisely the same result as in a building only a few feet away. The consumer living near the boiler house will have no advantage over the consumer living a mile away, since each will ordinarily carry the same house pressure—and consequently at the same temperature.

This system admits of the use of all kinds of radiators; but the new atmospheric radiator invented by Mr. Holly (shown in Fig. 3) is probably preferable to anything else, as the internal pressure and external atmospheric pressure are equal, admitting of the use of thin sheet metal in their construction. Steam may be admitted to the radiator so that it will cover any proportion of its inner surface, and being very thin, the same amount of surface will give off more heat than the ordinary heavy cast iron or wrought iron radiators.

The distributing pipes are freed from water by a steam trap (Fig. 4) invented by Mr. Holly. The water resulting from condensation in the building is delivered to an accumulator, from which it may be forced by steam pressure at any time to a tank in the attic, to be distributed through the house for general use as it may be required. A vertical section of a dwelling, provided with this heating apparatus, is shown in Fig. 5. The supply pipe and expansion joint are seen under the sidewalk. The regulator stands in the basement, and the radiators are shown in position on the several floors.

The steam used by each consumer makes its own record upon a strip of paper moved by the clockwork of the meter (Fig. 2). The pencil denotes the quantity of steam used, and the time of day at which each radiator in the house was put on or taken off. Thus each consumer pays for what he uses, and for no more. In this way equitable dealing is maintained between the company and its consumers.

The steam may be used to great advantage in cooking. In many large hotels the greater part of the cooking is done by steam and gas, but the apparatus is too expensive to go into general use. A stove, made of sheet copper, galvanized iron, or tin, at a slight cost, is used in connection with this system. The center opening is nine inches, and those around the outside six inches, making seven openings in all. The central steamer may be quite long, extending downward, with compartments, so as to cook several kinds of vegetables at the same time. There are receptacles for cooking oysters, custard, tea, coffee, puddings, etc., all at the same time. Cooking can be done more quickly and better than by a wood or coal stove, and without danger of burning, and avoiding extreme heat in the room during warm weather. The steam made with one pound of coal will cook these articles in less time than it would take to start a good coal fire. The steam can be taken from the air valve of the radiator through a small rubber hose, into the bottom of the central column of the stove.

In addition to the uses already enumerated the steam may be used as a source of power. Steam fire engines used in

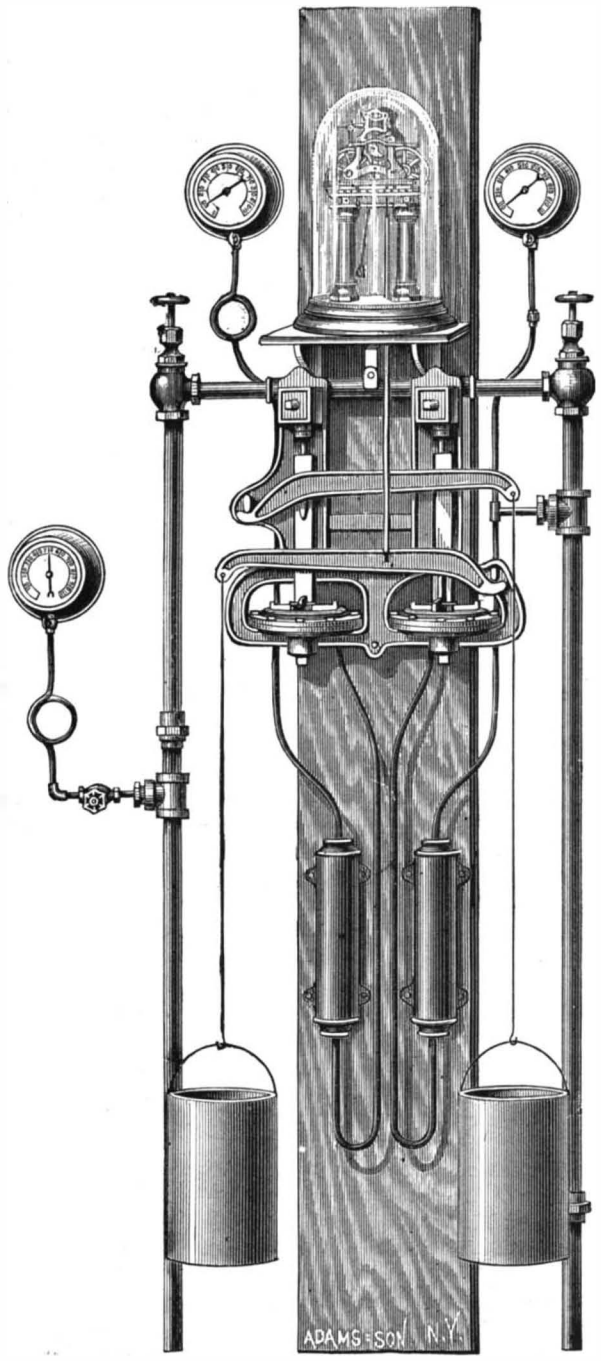

Fig. 2.—REGULATOR AND METER.

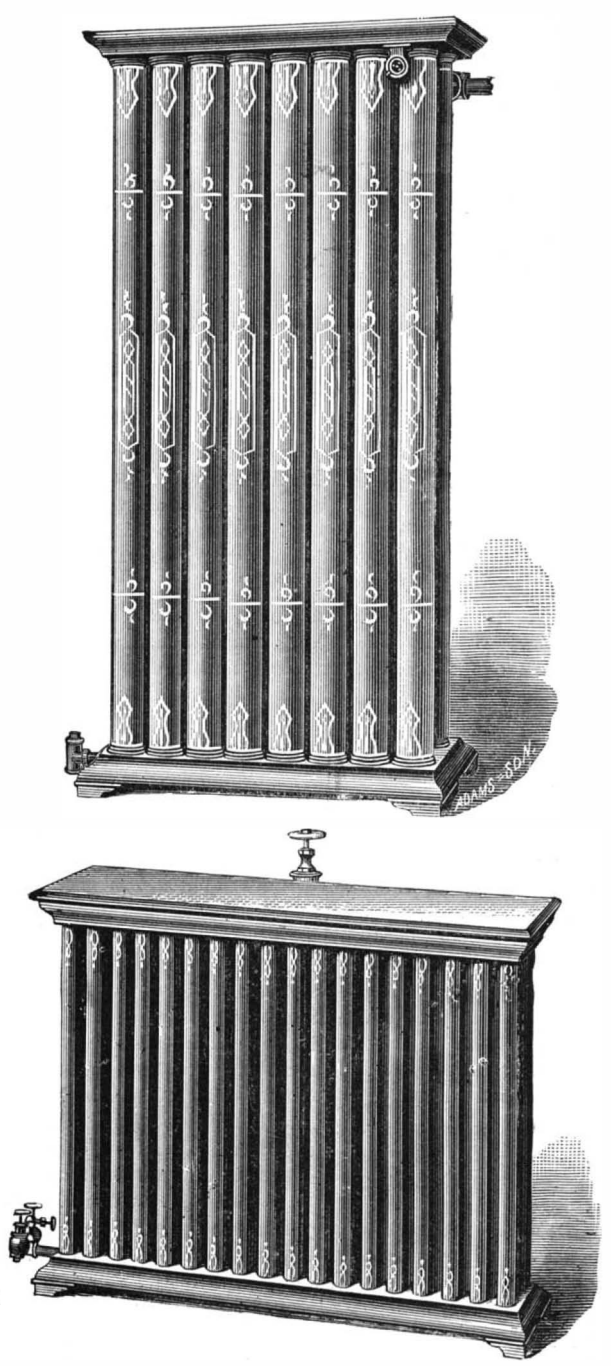

Fig. 3.—HOLLY'S RADIATORS.

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connection with the system will need no boiler, and may therefore be made very light and portable, and one of the principal items of expense will be avoided.

Snow and ice can easily and cheaply be removed by steam from streets and sidewalks, where in large cities it is frequently a serious obstacle to ordinary locomotion and traffic. A receptacle one by six feet, near the curbstone, with a steam coil at the bottom, will melt the snow as fast as delivered therein, and the water will be conveyed to the adjacent sewer. Experiments show that the cost in fuel of melting a ton of snow in this manner will not exceed five cents.

The matter of steam supply for large districts is no longer a question of experiment. Two or three years of actual test have established this system as one of the institutions that conduce to the comfort and safety of the masses; and we may expect at no distant day to see the inhabitants of our cities and villages enjoying the comforts of an equable temperature, a healthy atmosphere, and a safe and convenient power for driving machinery either small or large.

European Railway Speeds.

A paper has been published in Germany showing the different rates of velocity at which railway trains travel in different countries. According to this table, the swiftest runs are in England, between London and Dover, London and York, London and Hastings, where the average reaches 80 kilos—50 miles—an hour. In Belgium some trains travel as fast as 67 kilos—nearly 42 miles. The express trains from Paris to Bordeaux, Orleans line, average 63 kilos—39½ miles; the same speed is attained by the express trains between Berlin and Cologne. Between Bologna and Brindisi the average maximum is 50 kilos — nearly 31¼ miles. The average Austrian express speed is from 40 to 48 kilos—25 to 30 miles. On the Moscow and St. Petersburg line one travels at the rate of 43 kilos—nearly 27 miles—per hour; the same speed is observed in Switzerland between Geneva and Lausanne, and between Zurich and Romanshorn. But on the other Swiss lines one must be content with a slower pace. Thus from Zurich to Basel the highest speed is 38 kilos, and between Basel and Berne, 34—nay, between Soleure and Bergdorf the moderate gait of 25 kilos, or a little more than 15½ miles an hour, is observed. There are in Switzerland no purely "through" trains.

Havana the Pest-Breeding Place.

Dr. Chaillè, chairman of the Havana Commission, has lately written to the National Board of Health as follows:

As to the sanitary condition of Havana and of its harbor it would be difficult to devise conditions more favorable to propagate disease. Built upon a thin layer of earth which covers extremely porous coral rocks, this foundation is deeply saturated with the excrements of many thousands of human beings and of animals, continuously deposited throughout a long series of years. Nothing can be worse or more offensive than the privy system of Havana. Associated with the evil hygienic conditions of the city the harbor is, if possible, in even fouler condition.

This harbor, about one mile long, two thirds of a mile wide, and some thirty feet deep in the deepest places, has a difference between its minimum low and its maximum high tide of less than two feet; and into this almost stagnant pond is daily poured the sewage of the city, the offal of the slaughter houses, and the refuse from at least two large hospitals habitually infected with yellow fever and located on the very edge of the harbor. The fœcal odor from this harbor is often distinctly perceptible.

Among other things done, at the suggestion of Dr. Daniel M. Burgess, of Havana, to whom I owe much, I have inspected the ballast sold to and transported by ships from this port. Repeatedly has the ballast from this port been accused of causing outbreaks of yellow fever in ports of the United States, and as repeatedly has this been discredited. I have no hesitation in asserting, as the result of personal examination, that if there be anything whatever which can serve as fomites to transport yellow fever poison, the ballast from this port appears to be eminently fitted for this purpose. In my opinion, the National Board of Health should at once adopt such measures as may be needful to protect our ports against the dangerous risks they are subjected to by all ballast from this port.

New Use for Cocoanut Milk.

Dr. George M. Sternberg, Secretary of the National Health Commission, now at Havana, says:

I find that the air of our laboratory is loaded by minute spherical organisms, and contains bacteria not distinguishable from *bacterium termo*. I have made some experiments for testing apparatus designed for the purpose of keeping putrible fluids germ-proof, using for my test the liquor from the interior of an unripe cocoanut. This liquor possesses properties which will, I believe, make it of great value. . . . It is transparent as water when the nut is not too ripe, is contained in a germ-proof receptacle (the cocoanut), and when exposed to the air, bacteria and other organisms develop with astonishing rapidity. In my first experiment two portions from the same nut were placed in small beakers, one exposed to the air and the other protected by the glass cover and bell jar (Lister's apparatus), with previous precaution of heating apparatus to 320°. The following morning the portion exposed to the air was milky in appearance and loaded with bacteria large and small, and had upon its surface a pellicle containing the cells of some fungus; the portion under the bell jar was clear as water. I have succeeded in keeping this liquor in quantity for three days in a Florence flask, made germ proof by heating to 320° Fah., and provided with a cotton germ filter. I have made several good negatives of bacteria developed in cocoanut liquor for the purpose of testing my lenses and apparatus. I propose to continue the experiments commenced during the ensuing week.

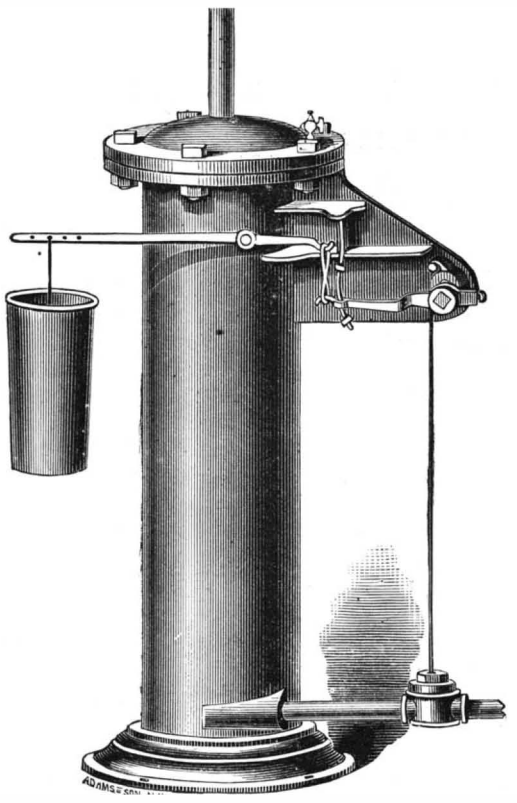

Fig. 4.—STEAM TRAP.

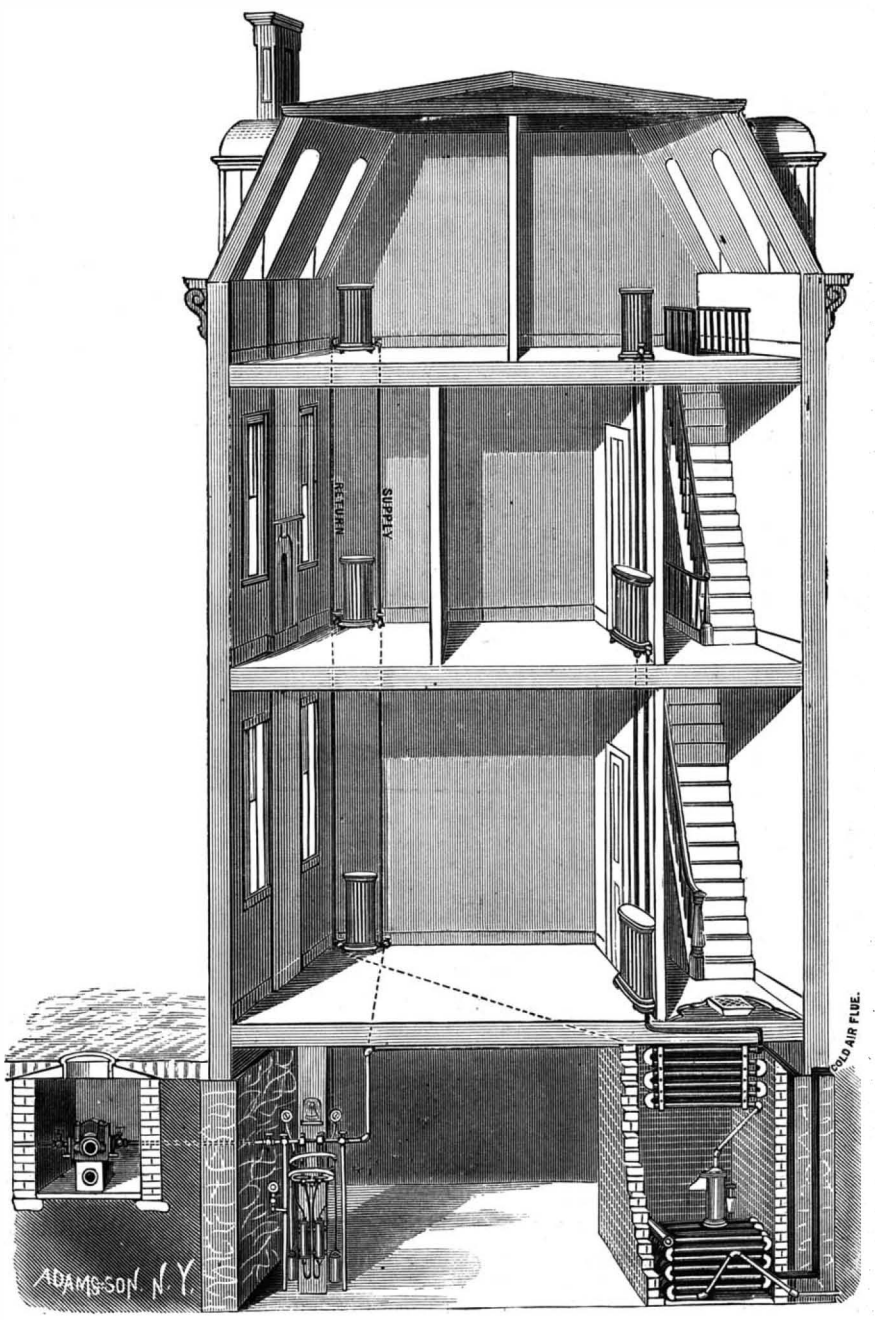

Fig. 5.—INTERIOR ARRANGEMENT OF HEATING APPARATUS.

Hollway's Metallurgical Process.

The Council of the Society of Arts, London, in their annual report, state that, looking at the character of all the papers brought before the Society during the year, the Council feels that they will compare favorably with those of any previous session. It would take too long to discuss the respective merits of all the papers which have been read since Christmas, they were all of considerable value; but amongst them are some deserving special mention, and in Mr. Hollway's paper on "A New Process in Metallurgy" were embodied the results of some of the most important experiments which have recently been made in that science. Mr. Hollway proposes to reduce metallic sulphides by using the ore itself as the chief fuel for the reduction. This is done by forcing a current of air through the molten sulphides. At first the combustion is started by using coke, but afterwards it is found that sufficient heat is generated by the oxidation of the sulphides, without any further addition of carbon. The process has not yet passed beyond the experimental stage, but should it prove a commercial success, it will effect a most important economy in one of the largest industries in this kingdom. So great was the interest aroused by Mr. Hollway's paper, that it became necessary to devote a second evening to its discussion; on both occasions the room was crowded, and the discussion was of an important and influential character, the opinions expressed being almost uniformly favorable. Of all the papers read before the Society during the year, Mr. Hollway's is the one the Council consider the most remarkable and the most important. Should the process at all carry out the expectations of its inventor—and he is supported by some of our leading chemists—it will add one more to the many great inventions which it has been the constant aim of this Society to introduce to the world.

Gelatine.

Gelatine, it is said, has a peculiar action on gum; if gum be added to gelatine, and the mixture sensitized with ammoniacal potassium bichromate, the behavior of the latter substance is very little altered by the addition of the former. Its solubility in hot water is somewhat increased, and to obtain the same degree of insolubility for the image as with pure gelatine the exposure must be longer. But if the mixture be acidulated with acetic acid, the film after exposure and desiccation is less soluble than one consisting of chromated gelatine only with acetic acid. Gum, therefore, renders an acid solution of gelatine less soluble, and the reason for this is believed to be that glutin and arabic acid form a compound solid only with difficulty. Borax thickens a gelatine solution, and the alkaline reaction of the same substance tends to render the chromated gelatine more insoluble. Calcium nitrate gives to gum an enormous power of adhesiveness.

Gas Lighting Experiments.

Colonel Haywood, C.E., the engineer to the City Commissioners of Sewers, London, has reported to them the results of an experiment now being made in a portion of Queen Victoria street, between Mansion House Station and the Poultry, with new gas burners, by the Gas Light and Coke Company, at their own expense.

The experiments commenced on the 6th March. The new lamps are fitted with Sugg's London Argand "Governor" burners, with glass chimneys. They are of two sizes—one consuming 22 cubic feet of gas per hour, the other 50 cubic feet. The gas is consumed in the smaller burners in two concentric columns or rings of flame, and in the larger burners in three rings. The burners are so arranged as to be self-lighting when the gas is fully turned on. They are in lanterns of an improved description, the smaller in lanterns octagonal in plan, and the larger in twelve-sided lanterns. Both lanterns are larger than those ordinarily used, and have the upper parts glazed with a new kind of white glass, which partly reflects and partly transmits the light. The lower portions are glazed with ordinary clear glass.

Proper means are provided for ventilation and preventing down draughts. There are 30 of the smaller and 5 of the larger lamps, and they supersede 55 ordinary lamps. The length of the street lighted is 353 yards. The burners consuming 22 feet of gas per hour have an estimated illuminating power of 80 candles, and thus 30 lamps are equal to 2,400 candles. The 50 foot burners have a power of 200 candles, and five lamps are thus equal to 1,000 candles. The ordinary lamps temporarily superseded are equal to 770 candles, or 4½ times less than the experimental lamps. The cost of the 55 ordinary lamps superseded is £4 17*s.* 6*d.* each per annum, or £268 2*s.* 6*d.*

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in all. The cost of the smaller experimental lamps is £19 1*s.* each per year, and of the larger £41 2*s.* 6*d.*, or £777 2*s.* 6*d.* in all. The new system, therefore, is nearly three times more costly than the old. The general result, therefore, is that the new system gives nearly 4½ times as much light as that in general use, and costs about three times as much. It should be added that the experiment is being conducted at the sole cost of the company.

Correspondence.

An Invention Called For.

To the Editor of the Scientific American :

There is one invention which is very much needed by the farmers of America, one which would add millions to their income, millions to the commerce of our country, and one which, if it can be invented and successfully operated, will make the inventor a millionaire. It is some kind of a machine by which the loss in the wheat crop will be reduced to, say, one fifth of the crop.

I will give you an idea of the loss in the crop by stating an experiment which I have tried this summer to test the loss. A neighbor had a field of 85 acres near my house, which was judged to make 10 to 20 bushels per acre. When fully ripe I selected one square yard, which I was sure was less than an average of the field, cut, dried, and rubbed it out very carefully. It weighed 6 oz. Calculating from that datum, the field made 2,571 bushels. When the crop was cut it was saved as clean as is usual, and was as cleanly thrashed as any I ever saw; and yet he only got 1,050 bushels, which shows a clear loss of 1,521 bushels; in other words, he saved about two fifths and lost three fifths of the crop.

I have never known more than one half of a crop saved even by the most careful management. It seems to me that one fifth, or 500 bushels, in 2,500 would be a heavy loss, but when it is 1,500 in a crop of 2,500, it is unbearable.

I think if you will present this subject, through the SCIENTIFIC AMERICAN, to the inventive geniuses of our country, that some of them will probably invent machinery by which this tremendous loss will be at least greatly reduced. It may be proper to say that the wheat was cut with cradles, and cut very clean, the field thoroughly raked, and it was thrashed by an A No. 1 steam thrasher. Will the farmers who see this try similar experiments next harvest and note their losses? Very respectfully,

F. W. CONNOR.

King George Co., Va., July 29, 1879.

[The foregoing is suggestive, to say the least; and we should be glad to hear of further experiments to determine the amount and the occasion of the discrepancy described. The loss of ripe grain by the depredation of birds, squirrels, rats, mice, and other vermin, is unquestionably considerable. There is a further loss by wastage in the process of harvesting, especially when any portion of the crop is over-ripe, due to tardy harvesting or to irregular ripening. But the assertion that three fifths of an entire crop—the actual returns of which exceeded the farmer's expectation—should be lost in harvesting, or that more than half our annual wheat crops are regularly lost that way, is simply incredible. We fear—no, not that; we are glad to believe—that our correspondent has but added another illustration of the too common habit of drawing sweeping conclusions from slender observation. One square yard is too small an area on which to base a judgment of the yield of over 400,000 square yards; as a test for the probable loss on millions of acres its value is inappreciable.—EDS.]

The Inductive Action of Lightning.—A Note from Professor Mayer.

To the Editor of the Scientific American :

The following account of experiments on the inductive actions of lightning, may be interesting to your readers, when viewed in connection with the remarkable experiments of Mr. George M. Hopkins, which were described in the July 19 number of the SCIENTIFIC AMERICAN, under the title "The Telephone as a Lightning Indicator."

These experiments of mine were made at my mother's residence, in the northwestern portion of the city of Baltimore, during the summer of 1863. The account of them here given is taken from a review of Professor Rood's investigations on the time of duration of the electric spark, written by me for the New York *Evening Post* of September 8, 1871.

Astonishing as is the fact of the concentration of the power of a lightning flash into such a minute interval, yet, as wonderful is the extent of the earth's surface affected by it; as will be seen from the following experiments of the writer, never before published: A galvanometer consists of a delicately suspended magnetic needle surrounded by a coil of copper wire, through which a current of electricity can pass; whenever this passage takes place the needle rapidly turns around its point of suspension. This being understood, I connected one end of the wire coil of the galvanometer with the water pipes of Baltimore, while the other end of the wire coil was joined to a gas pipe of the house which is situate in the northwestern part of the city. Thus a vast system of metallic wires stretched away three miles to the northwest, to the reservoir, and also extended to the gas works, distant two to three miles to the southeast.

A thunder storm was raging at the time, at so great a distance in the north that only the illumination of the clouds told when a flash occurred. Yet, whenever that flash took place, the needle of the galvanometer was instantly deflected through 10 to 20 degrees. The two occurrences were simultaneous, apparently, for I could detect no difference in the instant of their manifestation. Indeed, so sure an indicator of the flash was the galvanometer, that when I shut myself up in a dark room, signaling to an observer of the storm when the needle moved, and receiving from him a signal when a flash of lightning occurred, our signals were simultaneous. The next day it was ascertained that the storm was twelve miles distant to the north; therefore, at least five hundred square miles of the earth's surface had its electrical condition changed at each flash of the lightning.

ALFRED M. MAYER.

South Orange, N. J.

Swift's Comet of 1879.

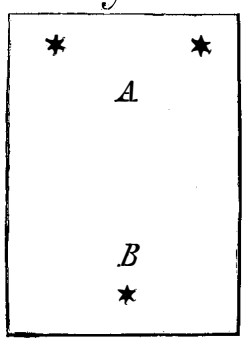
To the Editor of the Scientific American :

It has been my pleasure to obtain several excellent observations of Dr. Swift's comet of 1879.

Observations have been made with a Newtonian reflecting telescope of 5 inches aperture and 50 inches focal length, with B and C ordinary Huyghenian eyepieces, giving powers of 40 and 60 diameters respectively. One of the most interesting observations was made on the night of the 16th and 17th inst., when the comet was between three and four degrees to the left and slightly upward (at midnight) from Polaris or the Pole Star. Although a faint, misty object it was nevertheless quite conspicuous and unmistakable. For a comet it bears magnifying well, as it was much more satisfactorily seen with a power of 60 than 40 diameters. Later in the evening I applied a "solid" E eyepiece, giving a magnifying power of 140 diameters. This eyepiece, owing to the absence of reflections, which take place in the ordinary negative eyepiece, gives an intensely dark field, the sky appearing an almost jet black, and under this power the nucleus was quite bright and sparkling, although much of the outer, more hazy part was lost. The comet was also visible in a reflector of only two inches aperture, with powers of 30 and 45; and in clear weather I think no one could fail to see it with this aperture if possessed with keen eyesight, although I consider it a severe test with ordinary eyepieces.

During the three hours in which I had the comet under observation (with only occasional rests to render the eye more sensitive to details) I had a most beautiful and awe-inspiring view of its motion among the stars. The observations extended from 10 o'clock P.M. to 1 o'clock A.M. When first seen it formed, with three faint stars, a rather condensed Y, the comet being at the center or fork, but at 1 o'clock it had moved to the foot of the same, thus: A (Fig. 1) shows its first position and B at the close of observations. This was the inverted or telescopic appearance. During its passage from A to B the comet passed over a very faint star, which, although somewhat dimmed thereby, could still be seen through the hazy body of the comet. On the morning of the 23d inst. and this morning very interesting observations were made from about midnight until 1 o'clock. It has moved some distance from its position first referred to, and is now on a line drawn from the Pole Star to Beta Ursa Minor, and pointed at by Zeta and Eta of the same constellation (see Fig. 2). C shows the present position of the comet. It was first discovered 5° north

Fig. 1.



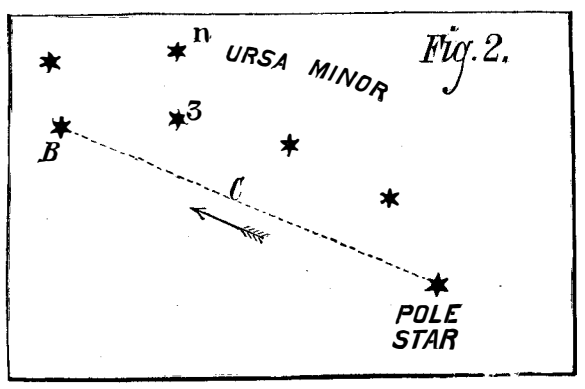


Fig. 2.

of the Great Cluster in Perseus, moving toward the north celestial pole of the heavens, over which it almost directly passed between the 13th and 14th of the present month. Its direction of motion is indicated by the dotted line and arrow in Fig. 2. It is moving a little more than 1 degree daily, and by taking C for its present position (25th of July) any reader with moderate telescopic aid and careful search may find it.

It is somewhat oval in form and with slight condensation, which to me does not appear central but nearer the forward or preceding limb. It is also my impression that under large apertures like the Washington telescope a somewhat blunted tail must be visible, the same cut away in the center, in other words double. WILLIAM ROBERT BROOKS.

Red House Observatory,
Phelps, N. Y., July 25, 1879.

ELECTRICAL LETTER BOXES.—Among the recent applications of electricity is an attachment to street letter boxes, so arranged that if an attempt is made to rob the box an alarm will be instantly sounded at the nearest police station.

MISCELLANEOUS INVENTIONS.

Mr. Edwin N. Cowdery, of Kalamazoo, Mich., has invented a windmill having its wheel and vane hung upon horizontal trunnions, so that the wheel will be balanced normally by the vane, and may be swung to present the edge of the wheel more or less to the wind. A weighted arm is connected to the vane-staff so as to move with the staff and wheel, and balance the parts in whatever position they may be turned by the wind.

A device for preventing saws when they are in motion from deviating from their proper course, and thereby producing boards of irregular thickness, has been patented by Messrs. I. N. Kendall, of Buckingham, and R. Hall, of Gatineau Mills, Quebec, Canada.

An improved cigar-box has been patented by Mr. Charles Heylmann, of Chicago, Ill. This invention relates to an improved construction of cigar-boxes, by which the cigars may be more advantageously exhibited for retailing, and the boxes arranged without any loss of space or inconvenience in the show-case.

Mr. William H. Allen, of No. 18 West 11th Street, New York city, has patented an improved automatic grain weigher and register for weighing grain, flour, and other similar substances as they flow from a spout into a hopper or receiver. The apparatus is so constructed as to deliver the substance in exact and uniform quantities and accurately register the quantity delivered. The invention consists in an arrangement of an open bottomed suspended vessel having a pivoted partition and supported upon a scale beam of peculiar construction. The relation of the supply spout and pivoted partition is such that the latter is held in position by the former until the vessel contains the required amount, when the downward movement of the vessel releases the pivoted partition, the grain escapes, and the recording mechanism is operated. The parts automatically regain their normal position and the vessel again fills and discharges.

Mr. Emanuel J. Trum, of Brooklyn, N. Y., has patented an improved calendar, which will display two successive months and days of the week in their proper order opposite figures indicating the days of the month. The invention consists in placing the figures of the calendar on a card, and above and below these strips of paper or card, on which are printed the month, year, and days of the week, one strip indicating the month last past and the other the current month.

Mr. William Wilmington, of Toledo, Ohio, has patented improvements in the moulds used in casting car wheels. The invention consists in inclosing the outer periphery and a portion of the bottom of the chill in a suitable ring, while a portion of the top of the chill is embraced by the bottom of the cope, provided with mechanical devices that will retain the chill in place when moulding the wheel, and at a later period will permit the chill to expand freely during the operation of casting.

Mr. Henry R. Robbins, of Baltimore, Md., has patented an improved letter box of the kind ordinarily located upon lamp-posts, which indicates the time of the collection of the mails throughout the day, provides an increased security for the letters, and keeps the letters and papers separate from each other.

Mr. Zelotes McKinley, of Camden, Mich., has invented an improvement in the class of washboilers constructed so that when placed over a fire a circulation of water is induced through the clothes, the hot water from below being raised by the steam and poured over the clothes in a stream or cascade to again find its way back to the chamber in the bottom of the boiler. The invention consists in the peculiar construction of the false bottom of the boiler.

An improvement in the class of middlings purifiers, in which an air blast passes through a sieve or screen for the purpose of carrying off the dust, fuzz, and light particles of bran, has been patented by Mr. Jacob Fitz, of Hanover, Pa. It relates to the construction and arrangement of parts, which cannot be readily described without an engraving.

A device adapted for attachment to a churn for the purpose of catching the cream that escapes through the dash opening and returning it to the churn, has been patented by Mr. Homer A. Noe, of Republic, Mo. The invention consists in a trapping device that is placed upon the dash rod and rests on the churn cover.

Mr. Fredrique R. Lewis, of Troy, N. Y., has invented an improvement in water coolers, which consists in furnishing a water cooler with a central water tube or chamber, the upper end of which is carried to the side wall of the cooler, and communicates through an aperture in the inside lining with a box provided with a filter and connected with a water supply pipe. The space between the walls of the cooler and the water chamber receives the ice. The water passes from the supply pipe through the filter to the water chamber, is cooled by the surrounding ice, and drawn off through a faucet in the bottom.

Mr. August Witte, of Kansas City, Mo., has invented an improved device for holding a door open, which consists in the combination of a base plate provided with lugs, a pawl provided with an arm and a hook, and a catch-plate provided with the flange, the parts being arranged so that the device may be readily operated by the foot.

In an improvement in extension stovepipes, patented by Mr. Robert R. Pattison, of Terre Haute, Ind., the inventor makes use of pipe in lengths, fitted together to move telescopically upon each other, and fitted with a spring catch of peculiar construction, whereby the pipes are held securely in any position to which they are adjusted.

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Mr James W. Winn, of Haverhill, Mass., has invented an improved boot and shoe protector, which saves the sole of the shoe from wear, as it does not allow it to come in contact with the ground at all. It prevents mud, gravel, dirt, etc., from getting in the seam between the upper and sole, and thus protects the seam from the cutting and wearing action; and it protects the lower part of the upper and the toe from rubbing against the gravel, stones, etc.

Mr. James Robertson, of East Cambridge, Mass., has invented an improved hook for securing and controlling animals for slaughter and for other purposes. It is so constructed that the struggles of the animal to escape after being secured will only cause the device to hold with more certainty.

Mr Ephraim S. Morton, of Plymouth, Mass., has patented an improvement in bows, which consists in making the bow in two parts and connecting these parts by a hinge joint, so that when the bow is bent the hinge is opened, and held in that position by the string.

Messrs. Robert B. and Henry H. Russell, of Orange, Tex., have patented an improved method of packing shingles, consisting in arranging them in alternate longitudinal and transverse layers, so as to create air spaces throughout the pack. The pack is secured together with two crossbars, of wood, drawn tightly upon its center by tin or sheet iron bands.

Mr. Henry A. Robertson, of Haskins, Ohio, has devised an elastic prop or bearing for carriage tops for supporting them when turned back; and the object of the improvement is to preserve the framework of the top.

An improvement in gates has been patented by Mr. George W. Addis, of Clarkston, Mich. The improvements relate to the class of gates which are fitted to roll back part way and then swing at right angles. The gate is inexpensive and durable; there is but little liability of sagging or racking, and it is easily operated.

Mr. John P. Simons, of San Francisco, Cal., has invented an improved gun-wiper, which consists of a helical spring, the fixed end attached to a metal stock that screws into the end of the ramrod. To the spring is attached the cloth forming the swab, so that when entered into the barrel the spring retracts, but at the same time exerts a continued pressure, and thus causes the swab to take up and remove all accumulations. When used as a scraper the swab is removed, and the free knife edge of the spring acts on the surface of the barrel and takes off the lead.

A tablet designed for the use of penmen, engravers, and all persons who have lettering to do, is the invention of Mr. Herbert W. Kibbe, of Utica, N. Y It is a self-instructor in lettering. Every letter in the alphabet can be formed complete with it, and with no more skill than is required in the use of a common ruler.

Mr. Amand Van De Wiele, of Brussels, Belgium, has invented an improved combined open grate and blower. The object of this invention is to modify or increase the draught in open fire grates by a movable blower that may be lowered upon the basket of the grate or elevated out of sight by simply turning a button attached to the front of the grate.

An improved camp chair, which is so constructed that it may be readily adjusted in an erect position, or at any desired inclination, which may be so compactly folded as to require no more space than the thickness of one of its frame timbers, is the invention of Messrs. William H. Gifford and William M. Bates, of Poughkeepsie, N. Y.

An improved device for attachment to windows to serve as a guard to the window when open to prevent children from falling out through it, has been patented by Mr. Solomon Weinhandler, of New York city. It is so constructed that it will rise out of the way when not required for use.

Mr. Charles A. J. Campbell, of Brooklyn, E. D., N. Y., has patented an improved detachable shoe for horses that may be attached as a temporary substitute in case a horse casts a shoe while on the road; they may be changed in width to suit any sized foot.

Mr. George W. Swain, of Brooklyn, N. Y., has patented an improved nursery chair, adapted to be used as a high or low chair, or as a carriage. It is readily changed from one form to the other, and is complete when used as a high or low chair.

Mr. James L. McKeever, of New York city, has patented an improved bed or cot, having parallel sides and rounded ends, and in a hinged cover of wire or other netting supported by a frame which is similar in form to the frame of the bed. The object of the invention is to construct a light strong bed having a protective covering of wire netting, to be used in hospitals and sick-rooms for the protection of patients against flies and other insects. It is also intended for use as an outdoor bed in warm countries.

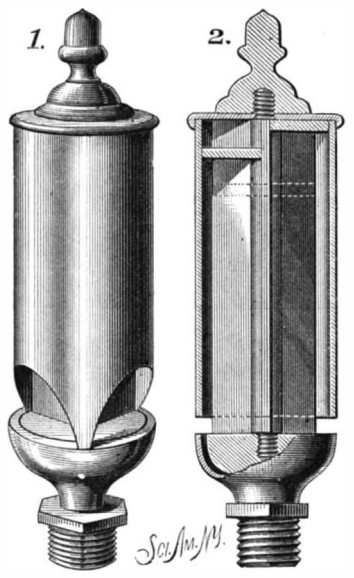
Mr. Amandus Getzschmann, of Omaha, Neb., has patented an improved device for stopping runaway horses, which consists of a movable sleeve sliding on two guide rails that project from the sides of the carriage or wagon pole. The sleeve is held in position by a stout hook that is pivoted in a slot in the pole, which engages in the corresponding hole in the sleeve. This hook is also provided with an eye, to which a strap is attached. This strap is led to the seat of the driver, so that he can at any moment unhook the sleeve and allow it to slide freely on the pole. Should the horses attempt to run away, the driver will pull the line, the sleeve is unhitched and slides forward, and a strap is drawn in the opposite direction, causing the bit straps to operate on the bits and bring the horses to a standstill.

Mr. Frank Imhof, of New York city, has patented a paper box for banjos, violins, guitars, and other similar instruments. The improvement consists in making the bottom and top and also the sides in separate parts, so as to avoid the trouble and difficulty of bending the sides around the edges for the whole length of the box

Mr. Augustus B. Wood, of Fountain Hill, Ark., has patented an improved matchbox or case for carrying matches in the pocket, which is so constructed that the matches may be forced out one at a time, as required, and at the same time ignited.

IMPROVED STEAM WHISTLE.

The whistle shown in the accompanying engraving is divided longitudinally into three or more compartments of different lengths, each compartment being provided with an aperture for receiving steam and with the usual mouth. The object is to produce three or more sounds simultaneously. The usual way of doing this is to attach three or

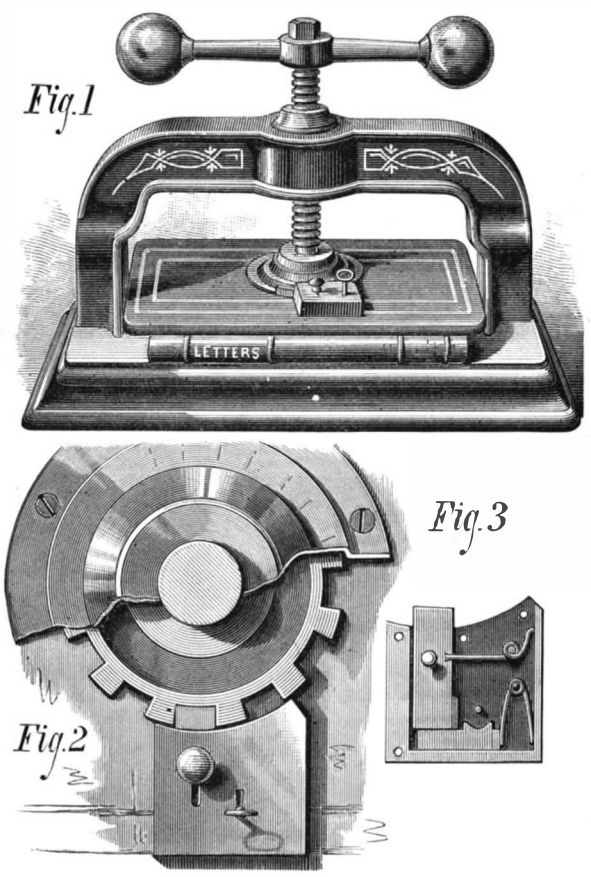


EINIG'S STEAM WHISTLE.

more steam whistles to a single pipe and admit steam to them all through a single valve, but this incurs the expense of three whistles and wastes an appreciable quantity of steam. The whistle shown in the accompanying engraving costs but little if any more than one of ordinary construction. More or less than three compartments may be formed in the same shell or tube, and the whistle may be made in either of the forms shown in the engraving. This whistle was recently patented by Mr. John Einig, of Jacksonville, Fla.

LOCK LETTER PRESS.

The letter press represented in the engraving secures letter copy books against abstraction and the curiosity of meddlers employed in or frequenting business offices. A toothed



HILL'S PATENT LOCK LETTER PRESS.

wheel is attached to the lower end of the screw, and to the platen is secured a lock the bolt of which enters between the teeth of the wheel on the screw.

When the platen is screwed down upon the letter book and the bolt of the lock is projected into the wheel on the screw as before indicated it will be impossible to turn the screw so as to release the book. The lock is so constructed that by pressing against a knob the press will be locked without the use of a key; but to unlock it a key is required.

The details of the lock are shown in Figs. 2 and 3. The operation of the lock is as follows: The inner spring presses the main bolt away from the gear, while the outer spring presses the supplemental bolt against the side of main bolt. When the main bolt is pressed into a recess in the toothed wheel the supplementary bolt at once springs past the end of the main bolt, and the press is locked. To unlock it, the key is inserted and the supplemental bolt is pressed away from the outer end of the main bolt, when that bolt instantly disengages itself by the action of the inner spring, and so remains unlocked until pressure is again applied to the key when it is desired to lock it.

This improvement is simple and inexpensive, and commends itself to any one having use for such an article. The patent was obtained July 9, 1878. For further information address the inventor, Mr. John Hill, of Columbus, Georgia.

Petroleum.

When we are told that at the present time over 1,800,000 gallons of petroleum or earth oil are brought to the surface every day in the oil regions of Pennsylvania alone, the mind is staggered by the contemplation of the magnitude of this comparatively new industry. So lavish is Mother Earth of her hidden stores of oil that it is sent to the surface much faster than it can be taken care of, or stored, and at the present time 300,000 gallons, at the lowest estimate, run to waste every day. The great United Pipe Line, and other methods of conveyance, utterly fail to convey the oil to markets, and the enormous tanks for storage are full to overflowing. There are tanks owned by companies which hold 5,000,000 barrels of oil, and all of them are full. The wooden tanks owned by individuals and private concerns amount in their aggregate capacity to as large a number of barrels, and these also are full.

Thus it will be understood that there are great lakes of oil above ground, as well as below; but there is good reason to believe that the subterranean deposits may with greater propriety be called oceans rather than lakes. The oil workers are evidently pumping from inexhaustible supplies in the rock chambers below, and what are called the "spouting wells" deliver their vast currents with the same impetuosity as when the drills first tapped the pent-up stores. An interesting inquiry arises as regards what becomes of the oil that cannot be secured; into what does it flow, and where is its final resting place? Any one who has visited the oil regions will know of the nature of the country, and readily understand that much of the oil flows into brooks or small rivers, and in time finds its way into the large rivers, and is lost ultimately in the Gulf of Mexico or the Atlantic Ocean. Still larger quantities are absorbed by the earth in ravines and marshy places, and thus it is lost to view. In the famous district one is led to exclaim, "Oil, oil everywhere, and no untainted water to drink." There is oil in the soil; oil in the springs; oil on the bushes and trees; oil in the atmosphere, apparently, oil on the clothing, and in the mouth, eyes, and hair of the workmen; the bread and coffee of the region have the odor of oil, and the beds are saturated with it.

How wonderful is all this! Well do we remember when the first vial of "rock oil" fell into our hands. It was called "Seneca oil," and it was claimed to be a most efficacious remedy for a variety of ills to which the human body is subject. The statement that it flowed spontaneously from a spring in Pennsylvania was received at first with much incredulity, as that was regarded as impossible; but in a short space of time the truth was known, and the oil was no longer regarded as a mixture devised by human hands.

American petroleum oil is now used as a source of artificial illumination in nearly all parts of the world. It goes along with rum, powder, and muskets to the savage tribes of Africa, and the mud houses on the banks of the rivers of the interior are illuminated by its combustion; it is found in the interior of the Turkish Empire, in Persia, in Egypt, in Palestine, in China, in Japan, and in the remote islands of the sea. For the paltry sum of fifteen cents we can purchase a gallon of the clear refined oil, and the cost of the light afforded, in comparison with gas as furnished at the lowest cost in cities, is as one to twenty in its favor. It is just now the most formidable antagonist of gas, and we can scarcely hope in the utilization of electrical force in the future, to secure light at a lower expense.—*Boston Journal of Chemistry.*

A 1,500 Horse Power Hoister.

The new hoisting machinery for the Yellow Jacket shaft, now being constructed in San Francisco, will be surpassed by nothing of the kind on the Comstock. It will be a double cylinder, direct acting hoist. Each engine will have a stroke of eight feet, cylinders 28 inches in diameter, and will be of a non-condensing character. They are to work at a steam pressure of 120 lb. to the square inch, and at 50 revolutions per minute will have a piston speed of 800 feet. While hoisting from a depth of 4,000 feet each will exert 1,500 horse power. A flat steel rope, 7 inches wide, ½ inch thick, and 4,000 feet long, will be used in hoisting. The Union shaft is now supplied with hoisting works, and will soon be furnished with pumping machinery superior to any now in use on the Comstock. The new pumping engine will be of the compound condensing style, the initial cylinder being 64 inches in diameter, with a stroke of 7 feet. The expansion cylinder is 100 inches in diameter and 8 feet stroke. It will have 8 strokes a minute and 136 feet of piston speed in the same time, and will exert about 1,500 horse power. It will operate a double line of 14 inch pumps, having a stroke of 10 feet.—*Virginia Enterprise.*

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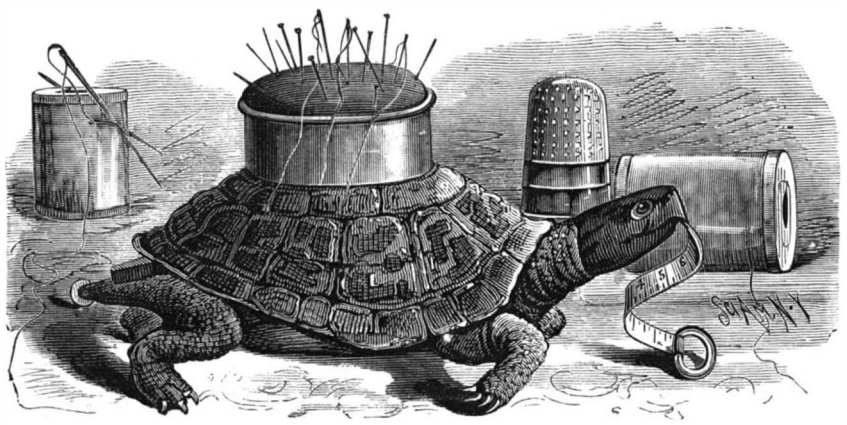
NOVEL WORK TABLE IMPLEMENT.

In the novel combination shown in the accompanying engraving the body of the implement, which represents a walking turtle, forms a paper weight. It is hollow and contains a spring acted drum upon which is wound a tape measure of three or more feet in length. The end of the measure extends through the mouth of the turtle, and is provided with the usual ring. Upon the back of the turtle there is a pin cushion, and just above the base of the tail there is a very hard beveled piece of steel, against which knives and scissors may be drawn to sharpen them. In the end of the tail there is a hardened steel wheel that is used as a glass cutter.

This combination of devices was recently patented in the United States and Canada by Mr. E. S. Heath, of Clintonville, Pa. It is one of those little articles that will be found useful in every household.



HEATH'S WORK TABLE IMPLEMENT.

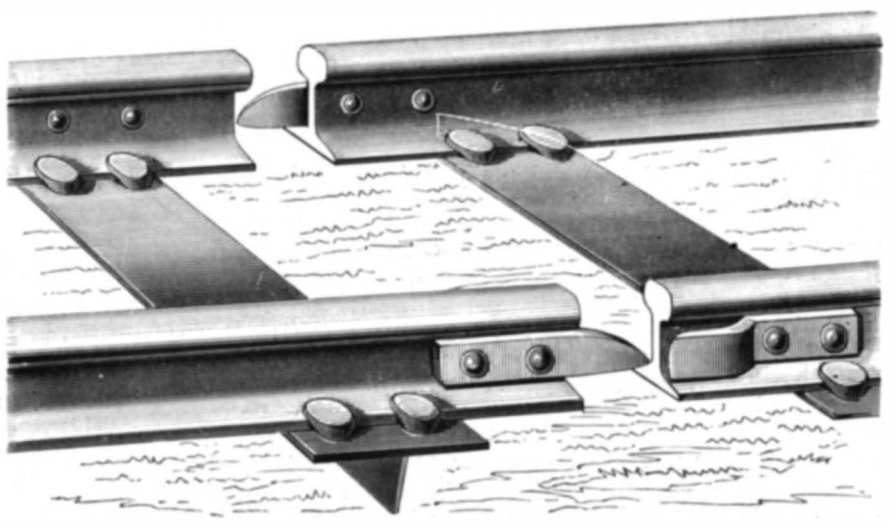
IMPROVED PORTABLE RAILROAD LOCK.

The portable railroad shown in the accompanying engraving is made in sections ten feet long; the two rails being firmly connected together by tie iron which is riveted to the rails. The sections thus formed are very light and yet strong and durable and capable of adapting itself to any surface. It may be used in hilly countries as well as upon flat lands.

The principal feature in this railroad is the locking device which secures the ends of the rails. As will be observed by reference to the engraving, it consists of a pointed piece of iron attached to one end of the rail and projecting a short distance beyond the rail end, so that it may be received by a mortise formed between a piece of iron attached to the end of the adjacent rail and offset, as shown in the engraving.

This lock holds the ends of the rails firmly, and at the same time admits of easily breaking the connections to insert a curve or a switch at any point without disturbing the whole road. For sugar plantations, mines, and quarries a road of this kind is invaluable; it is fast superseding cattle and carts, being much more economical.

Further information may be obtained from the patentee, Mr. John Turl, Turl's Iron Works, foot of West 28th street, New York.



TURL'S LOCK FOR PORTABLE RAILROADS.

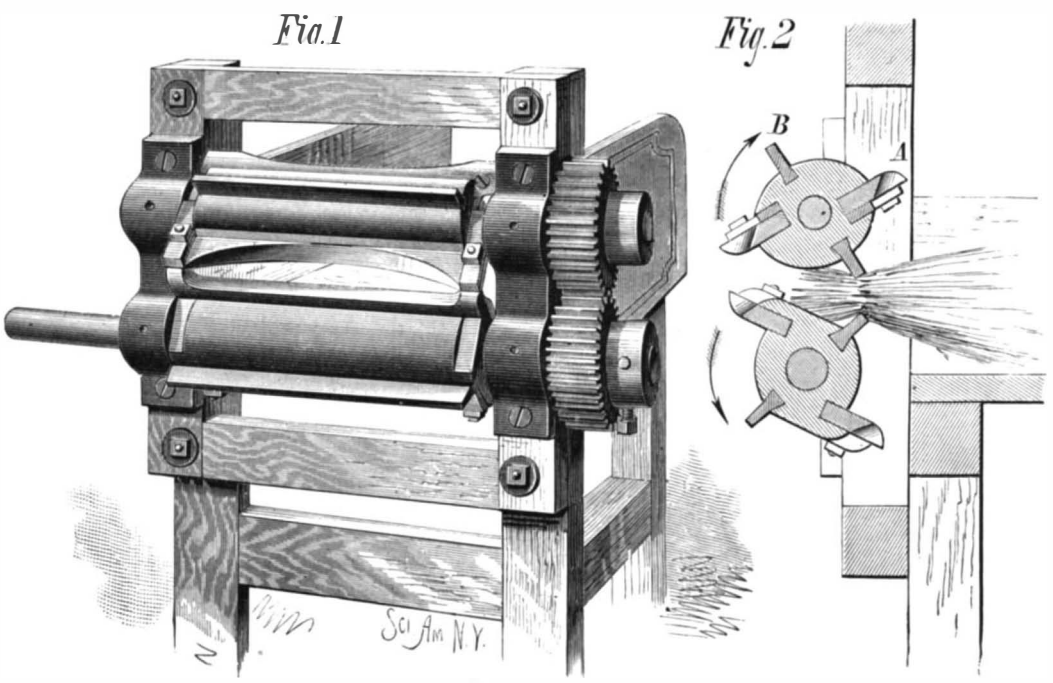
The Coal Crop.

In 1877 the anthracite regions of Pennsylvania yielded 21,000,000 tons, and although in 1878 the demand was curtailed to 17,000,000 tons, it is expected that close upon 30,000,000 tons will be required this year. Up to date 12,750,000 tons have been mined, against 7,300,000 tons for the corresponding period last year. The full average production is estimated at 500,000 tons a week, and it has reached on one occasion 655,000 tons. For the week ending July 12 the production was 531,613 tons, against 239,613 tons for the corresponding week of last year.

IMPROVED STRAW CUTTER.

We give herewith an engraving of a straw cutter invented by Mr. Charles G. Biedinger, of San Francisco, Cal., which possesses considerable novelty.

The cylinders carrying the cutters are geared together so that they revolve in opposite directions; each cylinder carries two knives, B, of peculiar form, arranged longitudinally and parallel with the shaft. The knives are concaved in the direction of their length, and the faces of the upper knives, which are straight, meet at every revolution the faces of the lower knives—which are rounded off toward the edge—so that the upper and lower knives may be said to roll together like the teeth of a gear wheel. As they come together the sliding of one over the other makes a shear that cuts whatever comes between easily and cleanly. These knives also draw forward the feed a certain distance at each revolution. When a longer feed is required than can be obtained by the knives alone, the rubber strips, A, are placed between the knives, and opposite each other, so that as the machine revolves a greater length of hay or straw will be drawn through. The knives being concaved lengthwise, the shearing cut will be from the ends of the cutters toward the center of the machine, conforming to the natural arrangement of the straw as it passes through the machine, the straw being thickest in the middle.



BIEDINGER'S STRAW CUTTER.

A good idea of the form of the knives and the arrangement of the rubber strips may be formed from the engravings, Fig. 1 being a perspective view and Fig. 2 a transverse section through the cutter heads.

Further information may be obtained by addressing the inventor, at 28 Sansome street, San Francisco, California.

RECENT MECHANICAL INVENTIONS.

An improved horseshoe machine has been patented by Mr. David H. Hatlee, of Clifton Park, N. Y. In letters patent granted to the same inventor, August 6, 1878, No. 206,726, a machine for making horseshoes is described. It has a horizontal bed that has a movable portion, and carries dies around which the shoe is formed. The present invention is an improvement on the former patent.

Mr. Charles W. Cannon, of Helena, Montana Ter., has patented an improved combination tool designed for use in preparing giant powder and other powder cartridges, so as to avoid the necessity of having to use a number of tools for this purpose. It consists in a combination tool formed of the handles pivoted to each other, and having a tack puller and a screwdriver formed upon their ends, the curved jaws having half round notches formed in their edges, and the blades or cutters attached to their sides.

An improved tire setter and fastener has been patented by Mr. David Fairbanks, of Rockingham, Vt. It is well known that a majority of blacksmiths cannot measure and weld a tire without making mistakes in its length of from one eighth to one fourth of an inch, and commonly they have to make several trials before succeeding in making a proper fit. The object of this invention is to insure perfect accuracy, to fit and tighten the tire at little expense, and in a manner which shall preclude all possibility of a mistake or misfit.

Mr. Frank A. Bowen, of Putnam, Conn., has invented an improved stripper spring for carding engines, which consists in combining a socket, base, sleeve, and rubber spring for receiving the impact of the flat. In carding machines at present the flat, when it is raised, bears against two steel springs attached to the crossbar; but these springs frequently break, causing loss of time, and sometimes tear the clothing of the cards. This invention is intended to remedy these defects, and to furnish a steadier and better spring for the purpose.

Mr. George William Schaefer, of St. Louis, Mo., has invented an improved machine for paring horses' hoofs, by which the hoofs may be pared with safety and with greater ease to the operator than when the paring is done in the usual way. It leaves the hoof level, so that no burning will be required to get a firm seat for the shoe.

An improvement in running gears for wagons has been patented by Mr. Joseph C. Fowler, of Arcola, Texas, in which the inventor makes use of a ball-and-socket coupling device applied back of the front axle, so that the forward axle is not weakened by boring to insert a king bolt, and the vehicle may be turned shorter and with less strain than when the joint is in line with the axle.

An improvement in looms has been patented by Mr. Paul W. Green, of Philadelphia, Pa., It consists of a box adapted to fit over the rods on which the picker moves, and to receive the elliptical rubber springs or cushions having at one end a solid bottom and at the opposite end, adjacent to the heads in which the rods are held, a movable bottom adapted to slide within it, and a spindle supporting bracket of a construction to permit the necessary movement of the bottom. The springs are held between the two bottoms, and the box slips over the movable bottom when struck by the picker.

Mr. Benjamin N. Shelley, of Anderson, Ind., has patented an improved carriage axle and axle box, which consists, mainly, in combining a shaft having one or more grooves around it with a packing and two clamping nuts or washers arranged upon opposite sides of said packing, so that when said washers or nuts are drawn together they force the packing down into the groove in the shaft and form a flange or collar fitting in the groove, that both prevents the escape of oil and serves to hold the shaft and bearing against longitudinal movement.

An improved machine for making paper boxes from pulp has been patented by Mr. Peter Cook, of Mattapan, Mass. It is so constructed that the formers may be cleaned immediately after being used and without stopping the machine. It will make the boxes rapidly and of uniform thickness, and will allow any kind of stock and chemicals to be used.

Mr. R. S. Munger, of Mexia, Texas, has patented an improved cotton gin saw cleaner, having a series of slotted knives or scrapers of peculiar shape, adjustably attached to a movable revolving support, and adapted to be thrust against the saws when cleaning is to be done.

An improved machine for printing paper hangings has been patented by Mr. Jacob J. Janeway, of New Brunswick, N. J. It is so constructed that the ground color and the other colors may be applied to the paper while passing once through the machine. It is simple and effective.

Mr. C. G. Damaschky, of Brooklyn, N. Y., has invented an improved station indicator, consisting in a revolving wheel fitted with radial indicating cards that are capable of radial movement, combined with a supporting frame that retains the cards inward, and is slotted for permitting the under card to drop by gravity to a position where it may be seen; also in sliding tongues and pawls for raising the cards and turning the wheel for bringing any one into position.

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THE FLYING DRAGON.

This beautiful little animal has, according to the measurements made by Cantor, a length of not more than eight inches, of which four and three-fourths inches belong to the long, slim tail. The nostrils are on the side and are directed upward, and the tympanum is not covered. The male animal has a neck comb, and both sexes have a small lump back of the eyes. Small scales of about equal size cover the body, and larger ones cover the sides. As in all dragons the color varies considerably, not only in different parts of the body, but also in one and the same scale. Their beauty is beyond all description. The head of the living animal is of a metallic brown or green color, and is ornamented with a black spot between the eyes. The back and the inner half of the wing consist of a mixture of metallic dark-brown and pink, in some cases in alternating stripes, with numerous black spots and curiously wound lines The color of the outer half of the wing varies between orange yellow and pink red, and has numerous irregular black spots and a silver edge. The members and the tail are covered with alternating stripes of pink and brown, and the eyelids are covered with radiating black lines. The neck is very light yellow, and the breast is of the same color covered with black spots. The flying dragon is found on the Sunda Islands, in Penang, and Singapore. Like other dragons it lives in trees entirely, and probably never comes to the earth unless forced to do so. Lacépède says that it is able to climb, walk, fly, and swim, but no proof of this assertion has been given. They generally rest on the tops of the trees, watching for insects, and as soon as they spy one they will leap for it, descending to the bough below; for although they can fly through the air in descending, they are not able to rise by means of their wings.

The female lays three or four yellowish white eggs, of about three eighths of an inch in length, which it is said they deposit in the holes in the bark of the trees. No further details are known.

THE FLYING DRAGON.—(*Draco volans.*)

The Insect Enemies of Books.

Dr. H. A. Hagen, according to the *Science News*, has recently made the insect pests of libraries the subject of an interesting lecture. Dr. Hagen admits the important fact that the white ant is present in Cambridge, and "everywhere else in the United States," and furthermore, that there have been two instances in this country of this insect causing a great destruction of books. Fourteen years ago, at Springfield, Ill., the bound copies of State papers were put aside in a room of the State House, which was not opened for a considerable period. When it was examined every book was found to have been more or less mutilated by ants. A Boston lady, a teacher in one of the Freedmen's schools in South Carolina, had even a more striking evidence of the destructive power of the insect. During the lady's absence from the school, in a vacation of six weeks, the ants ate through an entire library. A few of the least damaged specimens were saved as curiosities of literature and sent to Dr. Hagen. The volumes devoured were chiefly Bibles and prayer books.

The white ant is an uncertain danger. It may suddenly spring into activity and destructiveness, as it did here in the instance mentioned; as it did in France, where it all at once became formidable; or as it always does in Mexico, where old books and manuscripts are consequently rare. On the other hand, it may reserve its power for use in our native forests indefinitely, until some more tempting fare is provided by books locked up and not in use. Such books, however, are frequently of great value, and their bindings may be costly.

The other insect pests most known are the beetles belonging to the family *Ptinidæ*, and of these the larvæ of the genus *anobium* constitute the true "book worm." The ordinary methods used for destroying these may prove also injurious to the finer kinds of binding. Dr. Hagen suggests, as a beetle remedy, that the volumes be placed under the bell of an air pump and kept for a short time in the vacuum produced by the withdrawal of the air therefrom.

Dr. Hagen dismisses the cockroach (*Blatta orientalis*) with the remark that "libraries will not often be stored in cellars." In regard to the more recently imported ally of this species, the "croton bug" (*Ectobia germanica*), the editor of the *Science News* remarks that it is capable of doing damage upstairs as well as down. He says: "We have before us a volume, originally possessed of a bright red binding, which now has a speckled cover of white and brown blotches. The croton bugs ate off the red color almost wholly, and in some places penetrated a darker color, which seems to have been under the red. Probably the glue or the oil in the pigment of the binding proved attractive. The book lay outside, on a desk in an editorial 'sanctum,' far removed from the cellar, and was in occasional use during the period of its disfigurement. This instance does not stand alone; we have seen books that had been similarly attacked on the back, while standing on the shelves of libraries."

Before leaving this subject we may state that an interesting illustrated article, written for the SCIENTIFIC AMERICAN, on the subject of the various insects that are known to destroy books, may be found in our SUPPLEMENT, No. 138.

A Humming Bird's Nest.

Recently a humming bird's nest was found by some persons who had sufficient natural curiosity to overcome their compassion, and who captured the nest, two young hummers and the old one, took them home and had them stuffed. They are to be sent to a museum of natural curiosities in London. The nest is built on a little twig, and scarcely the size of half an English walnut. Both nest and twig are covered with little patches of lichen until it is almost impossible to tell one from the other, and the nest looks like a kind of natural excrescence on the twig. The nest is pliable, like a tiny cup of velvet, and the inside is lined with a white substance, as rich and soft as white silk. The little birds are about the size of bumble bees, very pretty, and they sit on a little perch just outside the nest, with open bills, while the old bird hovers over them to feed them.—*Elizabeth (N. J.) Journal.*

The Chemistry and Physiology of Aquaria.

An interesting and valuable paper has recently been written by Dr. W. Hinds on this subject; and, as the *Gardener's Chronicle* says, is deserving of wider acquaintance among physiologists than will probably be secured for it in the journal in which it appeared (Birmingham *Medical Review*). The author first alludes to the ideas prevalent as to the importance of purifying the water of aquaria; one being that a balance must be preserved between water plants and the animals, that the former may utilize the carbon dioxide expired by the latter. Another opinion considers that the chief means of aerating the water must be effected by agitation, which is only supplemented by the assimilating process of plants. Dr. Hinds proposes to examine into the questions: 1. The time required for water to redissolve or take up air after exhaustion; 2. The ultimate destruction of carbonic acid dissolved in water at ordinary pressure and temperature. 3. The relation of the law of atmospheric mutual diffusion of gases to the air taken up by water. By a series of interesting experiments he shows that carbon dioxide, instead of accumulating in the water, is continually being got rid of by its escaping from the water into the air. A jar holding about half a liter of tap water had six small fishes placed in it. They became exhausted in four hours, but the water then gave no trace of carbon dioxide. He found also that this same water regained its normal 2·5 per cent of air on exposure for four hours. A jar one foot deep and six inches in diameter, charged with carbonic dioxide, left in a close room, with gas burning, etc., so as to render it as unfavorable as possible, required seventy hours to liberate itself of the gas; while the same jar lost it in twenty minutes under the constant agitation of pouring it backward and forward from one vessel to another. The higher the temperature the more rapidly does the gas escape, nearly twice the length of time being required on a cold snowy day.

Dr. Hinds finally comes to the conclusion that the law of the mutual diffusion of gases hitherto applied to gases in air holds true as well for gases dissolved in water. The practical conclusion is, that no trouble need be taken about freeing an aquarium of carbon dioxide, but only as to resupplying it with air; and to do this he suggests jets of air (not water) in a minute state of division, combined with extensive and slow contact, as being more effective than the method now adopted in large public aquaria. Dr. Hinds' results seem parallel in a remarkable way to the conclusion of Schlösing as to the diffusion of ammonia. That physiologist regards the tropical seas as the great reservoir of ammonia, brought down from the continents by large rivers. The sea parts with its ammonia to the air at the high tropical temperature; but when it circulates and arrives at temperate regions, the air being cooled parts with it to the rain, which brings it to the earth. One still desires to know why oxygen should be absorbed at all, and why carbon dioxide is liberated by water; but the facts are obviously of vital importance as far as the maintenance of aquatic animal life is concerned.

The Best Kind of Silkworm to Rear.

According to the *Zoologist*, Dr. Wallace (a well known authority on the silkworm) remarked at a recent meeting of the London Entomological Society that he had experimented with nearly every kind of silkworm which had been introduced into Europe, and that he had come to the conclusion that the only one which would pay to cultivate in England was the *Bombyx mori*. It was true that the ailantus moth and others would produce a silk; but inasmuch as manufacturers, brokers, and silk merchants had invested large sums in the produce of *B. mori* they were not disposed to look with an eye of favor upon any other produce, which certainly would require much alteration in machinery and in the arrangements for business now extant. Moreover, the product of *B. mori* was a very superior article to that produced by any other worm.

It was true that in India, China, and elsewhere native products were prepared from the cocoons of indigenous moths, as, for instance, the Tusser silks from *Antheræa paphia;*

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Moonga silk from *A. assama;* Pongees, from China and Japan, from the cocoons of the ailantus moth and of *Bombyx pernyi;* likewise a very valuable silk from the Japanese oak feeding *B. yama-mai;* and he thought that the cocoons of species feeding on the gum trees near Adelaide, New South Wales, which were exhibited that evening to the society, might be utilized in a similar manner. But none of these silks were adapted to the machinery now in use in Europe, and therefore it would be better to allow native industry to collect the produce and fabricate the silks in the countries where produced.

MOLECULAR CHEMISTRY.—No. 5.

Besides the labors of Kopp and Schroeder, described in the last two articles, extensive researches have been made in molecular chemistry by numerous European investigators, notably by Loewig, Boullay, Filhol, and more recently Petterssen; but their work is not now of sufficient general importance to claim our attention.

In 1870 West read a curious memoir before the Société Chimique of Paris, in which he makes the old equivalents O = 200, H = 12·5, C = 150, etc., the basis of his investigations. To find the volumes of bodies, West compares them not at a common temperature, but at temperatures at which they expand equally when further heated. His standard of expansion is that of water at its maximum density, and to this standard the bodies to be compared are reduced to find the temperatures at which their densities give comparable volumes. Where the rate of expansion is not experimentally determined, West employs an assumed rate and looks to the concordance of his results for its confirmation. By this method he finds the molecular volumes of 29 of the elements to be multiples of 2·8125; each of them, moreover, has several volumes. Oxygen, for example, occurs with volumes equal to 12, 24, and 48 times 2·8125, to which he assigns the names of microtome, mesotome, and megatome respectively. Potassium, whose equivalent, according to this system, is 487·5, has three volumes, which are 72, 144, and 288 times 2·8125.

West enumerates 63 amorphous compounds of oxygen, hydrogen, and carbon, whose volumes are equal to the sum of the volumes of their constituents when calculated according to his method. He finds that when carbon is present as a megatome it is tetratomic, *i. e.*, it will combine with four equivalents of another body; when it is present as a mesotome it combines with only two equivalents. Nearly 200 examples are given in illustration. Again, the volume of oxygen determines the chemical properties of a body; the microtome produces acidity, the mesotome neutrality, and the megatome a tendency to combine with more oxygen.

In this country the credit of paving the way for further discovery belongs to Prof. F. W. Clarke, of the University of Cincinnati, the author of a work entitled "Constants of Nature," and published by the Smithsonian Institution in 1873. This book, which has now become indispensable to the chemist, contains not only the densities, the boiling and melting points, and formulas of all substances that have been studied, but provides for the correction of unavoidable inaccuracies by its references to the original authorities.

In December, 1874, Clarke published an important memoir in the *American Journal of Science,* with the object of determining the nature of the difference between water of constitution and water of crystallization; that is, between water intimately combined with a substance and water that may be driven off by heat without destroying the compound. To discover, in the first place, whether water of crystallization had a constant volume or whether it differed for different compounds, he determined the volumes of 31 salts, both when hydrated and when deprived of their water, from a great number of density determinations, and then proceeded as follows: The molecular volume of hydrated chloride of calcium, $CaCl_2 + 6H_2O$, is 133·9; that of the anhydrous, $CaCl_2$, is 49·6. Subtracting the latter from the former, 133·9 − 49·6 = 84·3, the molecular volume of $6H_2O$; dividing by 6 we have 14·05, the volume of water of crystallization in this salt, provided that no change takes place in the volume of $CaCl_2$ in combining or parting with its water. The other 30 salts, which contained from 2 to 18 equivalents of water of crystallization, yielded volumes ranging between the narrow limits of 13 and 15, and averaging 13·76. From this it is evident not only that water of crystallization has a definite volume, but also that no change of volume takes place in the rest of the salt when it combines with such water.

On the other hand, when H_2O is present as water of constitution a great diversity of values is found for its volume in different salts. Thus, the volume of potassium hydrate, K_2O,H_2O, is 54·8; that of the anhydride, K_2O, is 35·4; subtracting we have for H_2O the volume 19·4. Again, in iron sesquioxide we have for the hydrate, Fe_2O_3,H_2O, and the anhydride, Fe_2O_3, a difference of volume equal to 9·0. Hence we may reasonably conclude that when water combines in this intimate manner with a salt *both* undergo a change of volume.

In the *American Journal of Sciences* for April, 1877, Clarke published a list of the fluorides, chlorides, bromides, and iodides of lithium, sodium, potassium, and rubidium, 16 compounds in all, whose volumes proved to be almost exact multiples of 5·5. It was from this list that Schroeder derived some of the data for the support of his steric law.

It was reserved for the genius of Dr. Henry Wurtz, of Hoboken, to evolve entirely new and fertile ideas from the enormous mass of material which had accumulated for the study of molecular volumes. Availing himself of the density determinations collected by Clarke, and verifying them by reference to the original authorities, Wurtz subjected the views of Kopp, Schroeder, and others to the test of accurate computation. A vast number of bodies, simple and compound, organic and inorganic, were examined in this way, and the results showed discrepancies that could not be reconciled with each other or with the chemical relations of the bodies in question. While engaged in this work it struck Wurtz that, as all the molecules of a homogeneous body must occupy equal spaces or volumes, there should exist not simple multiple but *cubic relations* between the molecules of different bodies, especially when they are compared at some uniform temperature. This novel idea he afterward established, to his own satisfaction, by a long chain of evidence.

Before giving his proofs it will be well to state his method of interpreting the very considerable discrepancies that are often found in the densities of the same body by the most accurate experimenters, and that have proved a snare to many investigators of molecular volumes, who did not resist a very natural partiality for such numbers as would agree with their preconceived views. Wurtz believes that we are not warranted in rejecting any density determinations by reputable experimenters on the ground of personal errors or of impurities present in their specimens. In the case of common salt, NaCl, for example, we have the following densities: By Playfair and Joule, 2·011; Unger, 2·03; Sterry Hunt, 2·135; Stolba, 2·163; Hassenfratz, 2·2; Filhol, 2·24; Mohs, 2·26. He considers such variations of density as due to real differences of molecular volume produced by divers causes, such as the temperature at which the body was formed, the condition of the liquid from which it crystallized, etc. That he does not stand alone in this opinion is shown by the remark of Favre and Valson in the *Comptes Rendus* of the French Academy of Sciences for 1873, who were led to believe by their researches in crystalline dissociation "that the density of a salt is not an absolutely fixed element, but that it may vary slightly with the circumstances of its formation, *e. g.*, according as it has crystallized slowly or has been precipitated more or less rapidly from the mother liquor." As regards the figures just given for common salt, Wurtz believes that we have here a number of modifications or allotropes of the same substance, and also that the tendency to vary in density and consequently in volume is almost universal throughout the whole range of chemistry.

Another noteworthy feature in the mode of operation of this investigator is an attempt at obtaining greater accuracy in the comparison of the various density figures of two different compounds for the purpose of arriving at the value of some constituent common to both. Instead of simply averaging each series, each individual number of one is compared with all the numbers of the other. Thus, if there are four densities given of one body and six of another, twenty-four values are obtained, which are then averaged.

The starting point for the new system was found in the density of peroxide of hydrogen, $H_2O_2 = 1·452$ by Thénard. This specimen contained 2·6325 per cent of water. On making allowance for this impurity the density becomes 1·4642, and this divided into the equivalent of $H_2O_2 = 34$ gives us 23·220 for the volume. Now we have only to subtract the volume of water, $H_2O = 18·000$, to obtain the volume of the extra equivalent of O contained in the peroxide: $H_2O_2 - H_2O = O = 23·220 - 18·000 = 5·220$. Again, on the supposition that the two volumes of oxygen in H_2O_2 are equal, we have only to subtract their value from the volume of H_2O_2 to obtain, $23·220 - 2 \times 5·220 = 12·780$, the value of H_2, and this divided by 2 gives us for the hydrogen volume 6·390. Subsequent research proved these values to be slightly inaccurate, and 5·184 was definitively settled upon for the oxygen and 6·1408 for the hydrogen volume. It will suffice to select one among the many means of verifying these figures. The volume of liquid N_2O is 47·913, that of liquid N_2O_4 is 63·4625; difference, $O_3 = 15·5495$, and O = 5 1832.

When the new oxygen volume was substituted in a number of carbonates, the volume of carbon was found in nearly all cases to come out almost exactly 8. The approximations in these and other computations were the closer the nearer to 0° C. the densities had been determined. Now, 8 is the cube of 2.

Perhaps the reason that no one had before observed the close approximation of some volumic values to even cubes lies in the fact that they all contain a decimal point. The density of the diamond, for example, is 3·55. Dividing this into the equivalent 12, we find that carbon in this form has a volume of 3·380. Now, *we have only to omit the decimal point* to see that we have here as close an approximation to the cube of 15 = 3375 as we have any right to expect from the unavoidable imperfection of our experimental processes. If we make the equivalent of hydrogen 1,000 instead of 1, and thus multiply all the equivalent numbers by 1,000, all our volumes will come out as whole numbers, and cubic relations will at once become apparent.

Bunsen found the density of ice to be 0·91674. Its molecular volume is, therefore, the equivalent 18·000 divided by 0·91674 or 19,635. The cube of 27 is 19,683.

When Kopp found the volume of $CH_2 = 22 = 21·8$ at zero, if he had multiplied by 1,000 he would have obtained 21,800, which is not very far from $28^3 = 21,952$.

Clarke's volume for water of crystallization = 13·76, treated in the same way, becomes 13,760, and suggests the cube of 24 = 13,824.

The carbon volume 8, alluded to above, when multiplied by 1,000 is exactly the cube of 20.

As solids are to each other as the cubes of their diameters, the numbers obtained by extracting the cube roots of volumes may be regarded as molecular *diameters.* Thus, 20 represents the diameter of the carbon molecule in carbonates, 15 that of the diamond molecule, 27 that of the ice molecule, etc. This conception gives rise to a new system of notation, in which the numbers expressing diameters are placed directly under the symbols of the substances designated. To represent the common salt of Filhol and Mohs, Wurtz writes:

$$\underset{23}{\mathrm{Na}} \cdot \underset{24}{\mathrm{Cl}} = 2·251.$$

This means that the volume of Na is $23^3 = 12,167$, and that of Cl is $24^3 = 13,824$. Their sum, 25,991, divided into 58,500, the molecular weight of NaCl, gives us the density 2·251. (The density of a substance is its weight divided by its volume.)

We cannot do more here than indicate the vast amount of labor performed in these researches by simply stating that every important class of chemical compounds has been studied, tabulated, and shown to conform to the laws presently to be explained. For detailed information we refer to a memoir entitled "Geometrical Chemistry," in the *American Chemist* for March, 1876, and to later and more accurate publications in the last edition of "Johnson's Cyclopedia," chiefly under the head of "Volumes, Molecular." Since then Wurtz has continued his investigations with unremitting zeal, not satisfied with his generalizations until he had convinced himself of their universal application.

He found, in the first place, that the diameters of elementary molecules had a limited range of variation throughout the compounds into which they enter, and that their tendency to vary is directly as their basicity or electro-positive attitude toward the elements with which they are associated. In the different varieties of common salt, for instance, the sodium diameter will vary, while that of the chlorine remains constant. Stolba's variety is represented by

$$\left(\begin{matrix}\mathrm{Na} & \mathrm{Na}\\ 23 & 24\end{matrix}\right) \cdot \underset{24}{2\mathrm{Cl}} = 2·181.$$

Hydrogen, the most electro-positive element, has a range of 16 to 28, while oxygen, the most electro-negative of all, *never varies,* but always has the fixed volume 5,184, which is not an even cube, but curiously enough 3×12^3.

The diameters of some of the other common substances are: Chlorine in chlorates 20, in chlorides 24 or 28; sulphur in most metallic sulphides 20 in sulphates 24; carbon in hydrocarbons and carbonates 20; nitrogen 20, in cyanogen 24; silicon 20.

It the case of allotropes like the two varieties of common salt whose formulas have been given, and of organic homologues—that is, of series whose members differ in composition by the successive addition of the same elements—the tendency of the added molecule is to assume a diameter already present, or a diameter next above or below one already present. To understand this more fully compare the following volumic formulas for some members of the alcohol series:

Wood spirit, $\underset{27}{2\mathrm{H}d} \cdot \underset{27}{2\mathrm{Hm}}$

Spirit of wine, $\underset{27}{2\mathrm{H}d} \cdot \underset{27}{2\mathrm{Hm}} \cdot \underset{26}{2\mathrm{Hm}}$

Propionic alcohol, $\underset{27}{2\mathrm{H}d} \quad \underset{27}{2\mathrm{Hm}} \cdot \underset{26}{2\mathrm{Hm}} \cdot \left(\begin{matrix}\mathrm{Hm} & \mathrm{Hm}\\ 25 & 26\end{matrix}\right)$

In these formulas H*d* stands for H_2O with the ice diameter, and Hm for H_2C. In the former Wurtz gives the name of hydor and to the latter that of homologen. Observe that the diameter of each additional molecule shows the tendency just mentioned. It was at first supposed that this tendency, to which the name of engymmetry was given, applied also to other classes of compounds; but it afterward turned out that they exhibited a remarkable regularity of a different kind. Before taking up this subject it will be expedient to learn Wurtz's views with regard to the nature of the components designated by him as H*d* and Hm. In constructing his volumic formulas he found very numerous instances in which the calculated densities could not be made to agree with those obtained experimentally, except on the theory that in these bodies certain ones of the elements were more intimately combined with each other than with the other constituents, and that they formed groups expanding and contracting *as a whole.* Of such groups, or radicals as he calls them, he at first found only four, viz., cyanogen, ammonium, Hm and H*d*; but he now holds that others may be formed from the last two by substitution. Such a view, of course, sweeps away a great army of hypothetical radicals in organic chemistry—a proceeding which chemists will be very loth to permit.

When the formulas of organic bodies are examined according to the method just indicated, and the volumes of Hm and H*d* have been subtracted, there will be found remaining a carbon nucleus consisting of C in alcohols, ethers, and fatty acids, of 3C in aldehydes, of 4C in benzoles and olefines, of 4C in sugars and starches, etc. The variations in diameter of these carbon molecules appear to be connected with the liquidity and solidity of a body, and also with its boiling point. Thus, in the paraffine series we have:

Butane,	$\underset{24}{\mathrm{C}}$	$\underset{24}{3\mathrm{Hm}} \cdot \underset{22}{4\mathrm{H}}$	= Density	·593.	Observed density ·600
Pentane,	$\underset{24}{\mathrm{C}}$	$\underset{24}{4\mathrm{Hm}} \cdot \underset{22}{4\mathrm{H}}$	= "	·6445.	" " ·6413
Solid paraffine,	$\underset{20}{\mathrm{C}}$	$\cdot 19\underset{24}{\mathrm{Hm}} \quad \underset{22}{4\mathrm{H}}$	= "	·9002.	" " 89

The first two are liquids and have C = 24; in the third, which is solid, C = 20. Between them there are 14 members of the series which furnish concordant formulas.

The 16 specimens of butyric alcohol, $C_8H_{20}O_2$, whose densities have been determined by different chemists, may be

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divided into four varieties or isomeres, boiling respectively at 116°, 108°, 98°, and 82·5°. Their volumic formulas would be as follows:

1. $\frac{C}{20}\ {}^{7}\frac{Hm}{24}\cdot {}^{2}\frac{Hd}{24}\cdot\frac{H\ H}{28\ 29}$ = Density ·8279. Observed mean of 6 = 8235
2. $\frac{C}{24}\cdot {}^{7}\frac{Hm}{24}\cdot {}^{2}\frac{Hd}{24}\cdot {}^{2}\frac{H}{28}$ = " ·8125. " " " 6 = ·8161
3. $\frac{C}{28}\cdot {}^{7}\frac{Hm}{24}\cdot {}^{2}\frac{Hd}{24}\cdot {}^{2}\frac{H}{25}$ = " ·8333. " " " 2 = ·8385
4. $\frac{C}{28}\ {}^{7}\frac{Hm}{24}\cdot {}^{2}\frac{Hd}{24}\cdot\frac{H\ H}{26\ 27}$ = " ·806 " (solid) 1 = ·8 75

$\frac{C}{32}\ {}^{7}\frac{Hm}{24}\cdot {}^{2}\frac{Hd}{24}\cdot {}^{2}\frac{H}{25}$ = " ·7854 " (melted) 2 = 7849

Here the carbon varies through the series 20, 24, 28, 32, and in the last example it expands from 28 to 32 when the body changes from the solid to the liquid state.

Upon examining the above examples and those which are to follow, it will be observed that *there is a tendency to assume diameters divisible by four.* The second butyric alcohol is a perfect example. It must be remembered, however, that these and other volumic formulas are constructed to represent the *means* of all available density determinations of any given body There is every probability that there exists in every case an isomere whose density will lead to a perfectly normal formula in which all the diameters are multiples of four, while other specimens of the body exhibit only more or less perfect approximations. This probability has the support of hundreds upon hundreds of instances. We can only give a few to show the different phases of this tendency.

Where inorganic compounds are found with varying densities this variation is caused by the most positive or basylic constituent.

Sulphate of potash, $O_4\cdot\frac{S}{24}\cdot {}^{2}\frac{K}{23}$ = 2·888. Maximum observed D.= 2·88

" " " $O_4\ \frac{S}{24}\ \frac{K\ K}{26\ 27}$ = 2·423. Minimum " D.= 2·407

The potassium alone varies, and the variation is here nearly 4 diameters. This is often the case between maxima and minima, while the intermediate isomeres differ by half or whole diameters. The densest carbon, diamond = $\frac{C}{15}$ = 3·556, while the lightest, lampblack = $\frac{C}{19}$ = 1·75; difference = 4 diameters. Again, we have.

Quartz, $= O_2\cdot\frac{Si}{23}$ = 2·662. Observed density, 2·663

Lightest silica known = $O_2\cdot\frac{Si}{27}$ = 1·83. " " 1·815

The latter is obtained by the ignition of opal.

When an electro-negative unites with different positives of the same group, the positives increase by 4 or $4n$ diameters.

Chloride of lithium, $ {}^{2}\frac{Cl}{24}\ \frac{Li}{19}\ \frac{Li}{20}$ = 1·999. Observed D., 1·998

Chloride of sodium, $ {}^{2}\frac{Cl}{24}\ \frac{Na}{23}\ \frac{Na}{24}$ = 2·181. " D., 2·172

Here the negative chlorine remains the same, while Na is greater by 4 diameters than Li.

When a positive unites with several negatives of the same group, the resulting series will show a variation of the positive through 4 or $4n$ diameters.

Chloride of sodium, $ {}^{2}\frac{Cl}{24}\ \frac{Na}{23}\ \frac{Na}{24}$ = 2·181. Observed density, 2·172

Bromide of sodium, $ {}^{2}\frac{Br}{24}\ \frac{Na}{27}\ \frac{Na}{28}$ = 2·973. " " 2·952

Changes from solidity to liquidity and from color to blackness are accompanied by variations of 4 or $4n$ diameters. Examples of organic bodies illustrating the first of these changes have already been given.

Tin chloride, solid = $ {}^{2}\frac{Cl}{24}\cdot {}^{2}\frac{Hd}{24}\ \frac{Sn}{29}$ = 2·82. Observed D. = 2·76

" " fused = $ {}^{2}\frac{Cl}{28}\cdot {}^{2}\frac{Hd}{24}\cdot\frac{Sn}{25}$ = 2·581. " " = 2·588

Elements uncombined change only through half or whole diameters instead of $4n$:

Solid potassium $= \frac{K\ K}{35\ 36}$ = ·871. Observed D. = ·87

Melted " $= \frac{K}{36}$ = ·836. " " = ·842

To illustrate the change from color to blackness, we have:

Cinnabar red cryst., $ {}^{2}\frac{S}{24}\cdot\frac{Hg\ Hg}{24\ 25}$ = 8·127. Observed D. = 8·124

Meta-cinnabar black cryst., $ {}^{S}\frac{}{20}\cdot {}^{2}\frac{Hg}{28}$ = 7·746. " " = 7·748

Such are, in brief, the results of this latest and most extensive of the researches into molecular volumes. It is not the writer's purpose at present to discuss the reasoning or the methods pursued by the different investigators, but simply to present for the first time their work and their views in a connected form, with the hope that a knowledge of the subject may thus be promoted among those who are sufficiently interested in theoretical chemistry to give it their careful attention.

C. F. K.

Is it Education or Accident?

Technical education supposes that a child must be educated for the sphere he is expected to occupy in life. Advocates of a purely technical education use frequently such phrases as "laboring classes," "station in life," "educated classes," "cultured society," "upper classes." Whether this is wise in republican America as in monarchical Europe remains to be seen. Experience has shown that it is exceedingly unwise to suppose that a certain boy is to make a Congressman, while another will peg boots. The issue usually shows that the young lawmaker makes a cobbler, while the predestinated bootmaker becomes a foreign minister. Some of our very best and most learned men were not intended by their parents to occupy very high stations in life. It is dangerous to "suppose" very much in reference to any boy, continues *Barnes Educational Monthly*, in this enlightened age.

ENGINEERING INVENTIONS.

Mr. Joseph R. Winters, of Chambersburg, Pa , has patented in this country, also in England, Canada, France, Germany, and Belgium, an improved fire escape ladder and hose conductor, which may be easily raised to any required height within the limits of the capacity of the machine, and it may be inclined at any desired angle. It carries the hose up with it, and is arranged so that it may be used in lowering timid or infirm persons, or articles of furniture. The invention consists in a novel and ingenious arrangement of devices, which cannot be readily described without an engraving.

An improvement in the class of car couplings, whose engaging devices are pivoted hooks or draw bars, has been patented by Mr William W Scott, of Sumner, Iowa It consists in the employment of coupling hooks or draw bars, having pivoted heads to adapt them for engagement with bumpers having slotted heads, which are inclined, the object being to enable cars of different heights to be coupled

An improved car coupling, designed to obviate the necessity and its attendant danger of going between the cars, is the invention of Mr. Charles Ahrenbeck, of Navasota, Texas. The improvement consists in the particular means applied to an ordinary draw bar for holding and centering the ordinary form of link, and elevating the same so as to enter the opposite draw bar.

A coupling for cars that will automatically couple them at all times, whether the latch is up or down, and which is arranged so that the draught at no time falls upon the pin or pivot of the latch, but is borne directly by the draw head, has been patented by Mr. Patrick M. Bracelin, of Davenport, Iowa. This invention obviates the necessity of going between the cars either to uncouple or couple them.

Mr Robert Hay, of Mineral Point, Wis , has invented an improved draw bar, which consists of a frame adapted to be connected with the tender, and provided with a coupling bar carrying cross heads and a spiral spring within the frame, so that when drawn or pushed it is cushioned by the spring, and thus relieves the shock and strain on the engine

Messrs. Robert M. Pringle and William D. Robb, of Elizabethtown, Ky., have patented an improvement in safety valves, which consists in changing the form of valve in common use, so as to make it extremely sensitive to any variations in steam pressure, and so that the escaping steam shall assist in closing as well as in opening the valve, and in inclosing it in a case provided with a set screw and jam nut, in order to adjust and secure the valve at will.

Mr. Charles A. Mentry, of Newhall Station, Cal., has invented an expanding reamer for increasing the bore of oil and other deep wells, that can be let down through the tube and expanded when it reaches the proper point for the reaming to begin. It consists of a forked reamer incasing an expanding spring plunger projecting through its head, where it is provided with a needle controlled by a trigger, from which a halyard leads up to the surface.

An improvement in the class of coupling devices which consist of pivoted hooks, has been patented by Messrs Seth S. Watrous and William Gerber, of Fremont Center, Mich. The improvement consists in the combination of the two cams projecting in opposite directions, with the coupling hooks pivoted within the draw head on vertical pins, but in different horizontal planes, the cams being arranged in relation to the hooks, so that the latter may be spread when the cams are turned.

A Runaway Railway Wheel.

A most singular railroad accident lately occurred on the Erie Railway at Middletown, N. Y. The train known as the steamboat express, one of the fastest on the road, had just left the station and attained its full speed, when the forward wheel of the front truck of the locomotive became detached and started down the track by itself. Such was its impetus that it ran fully a hundred yards, then left the track and ran through the brick wall of Bunnell's lumber yard before it came to a standstill. The cause of the accident was a heated and worn out journal. Travel was delayed on the eastward bound track nearly four hours in consequence.

Foreign Fruit Trade of New York.

According to the annual report of the inspector of customs the value of the green fruit imported at this port during 1878 was as follows:

Varieties of fruit.	Per centum duty.	Value. Dollars.	Amount of duty. Dollars.
Oranges and lemons	20	2,802,966	560,593.20
Grapes	20	232,004	46,400.80
Pineapples	20	87,666	17,533.20
Bananas	10	395,619	39,561.90
Limes	10	3,564	356.40
Grapefruit, shaddocks, mangoes, plantains, watermelons, cantaloupe melons, and a few other varieties of green fruit not named	10	15,711	1,567.60
Cocoanuts	Free.	197,520	
Total, 1878		$3,735,050	$666,016.60
Total, 1877		$3,148,992	$564,140.30
Increase of value and duty for 1878		$586,058	$101,876.30

There was a large increase in the quantity of fruit imported from the West Indies, except in the case of oranges and pineapples. The falling off in pineapples is supposed to be due to the establishment of large canning factories in the West Indies. An extraordinary increase, amounting to two and a quarter millions, occurred in the importation of cocoanuts. Of Mediterranean fruit, the importations in 1878 were lightly in excess of those of the preceding year. Of grapes, the number of packages was largely in excess of those of any previous year, namely, 45,000 barrels and 12,000 half barrels. The pomegranates numbered 200 cases. The Mediterranean oranges and lemons number 1,254,802 boxes and cases. The average loss on oranges was 36 per centum, and on lemons 20 per centum.

From the West Indies, 12,942,675 oranges were imported, with an average loss of 45 per cent. Of bananas there were 560,837 bunches imported—an increase of 157,916 bunches over 1877. Twenty-three per cent of the 2,704,773 pineapples perished on the voyage. Nearly 10,000,000 cocoanuts were imported, with an average loss of 9 per cent.

Overland Boating.

The proposed construction of a ship railway across the Isthmus of Panama has called to mind the similar though smaller portage system formerly employed by the State of Pennsylvania. For many years the system was used in transporting canal-boats (built in sections) from the canal between Conemaugh (near Johnstown, Penn.) on the western side of the Allegheny Mountains, and Hollidaysburg on the eastern side. By this arrangement boats without breaking bulk were passed between Pittsburg and Philadelphia via Columbia. The portage of the mountains was made by means of inclined planes, at the top of which were stationary engines to draw up or let down the cars or trucks, using a heavy hemp rope running over pulleys between the rails to keep it from the ground. After reaching the top of the plane a small locomotive was used along the "levels," as they were called, until the next plane was reached. By this means transit was quick, and the expense of handling the cargo twice was avoided. After the construction of the Pennsylvania Railroad, and the introduction of locomotives that could draw loads up grades that years before were only capable of ascent by means of ropes and stationary engines, the old portage road of the State, becoming the property of the Pennsylvania Railroad Company by purchase, was abandoned; and now the traveler can see, as he is whirled along in a palace car, only the ruins of what was forty years ago one of the most wonderful public improvements of the age.

A similar system is still employed in New Jersey for changing canal-boats laden with coal from one canal system to another.

The Export Trade in Staves, Shooks, and Hoops.

"The great majority of the sugar and molasses hogsheads which are emptied of their contents in this city," says the Boston *Commercial Bulletin*, "find their way back to the West Indies again. The hogsheads are purchased from the refiners by an enterprising firm, who take them apart, clean the staves and bundle them up into shooks, and export them, together with their heads, to Cuba. This firm have one yard in South Boston in which they thus prepare 2,000 hogsheads per week for export. The export trade in new shooks to the West Indies is also an important one, these last selling at from $1 to $1.75, while the second-hand shooks bring but 50 to 75 cents. The stave trade of Boston is nearly all in the hands of one firm; and as more than $300,000 worth of cooperage stock of various kinds are exported, in addition to what is used in this vicinity, their business is a large one. The staves, which are so largely exported from Boston to the Mediterranean and to England, are white oak. Sugar barrels are also made from elm, and in New York are being made of a single piece, cut out for the purpose. The oak staves come from the West, largely from Michigan. Staves are usually exported in the rough or unfinished state, and range all the way from $60 to $150 per thousand for hogshead staves, and $80 to $200 per thousand for pipe staves."

Another Railway Bridge for Niagara River.

In 1849 the Lewiston Suspension Bridge Company and the Queenston Suspension Bridge Company were organized, the first on this side and the second on the Canada side of the Niagara River. They built a highway suspension bridge at Lewiston, and maintained it for some time. It blew over one day and was never repaired. The ruins of the structure still remain in the form of masonry on each side of the river, and one cable still suspended. The Oswego *Palladium* says that the Rome, Watertown and Ogdensburg and the Great Western (Canada) railway companies have bought the stock of the old companies above named and formed a company with $1,000,000 capital to build a bridge at Lewiston. The work will be begun immediately. The bridge will be one of the finest of the kind in the world. The river at the point to be crossed is 600 feet wide. The bridge will be a steel truss structure of one span, and will be a railroad and highway bridge. The object of the parties in interest is to accommodate the local trade of the Rome, Watertown and Ogdensburg road and that of Northern New England and the West.

Coupe Cars for London.

An order for fifty two-horse cars for use in South London, England, was recently completed by a firm of car builders in this city. The same company are now building for the same market a number of one-horse cars of the "bobtail" pattern. In London they will be known as coupés. These cars are provided with pay boxes, have horse guards at the dashboard, and life guards in front of the wheels, and are hung on Mr. Stephenson's new method, which makes the riding easy. They are finished in hard woods, and the seats are upholstered in fancy carpets. American cars are preferred in England for their superior strength and lightness.

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RECENT DECISIONS RELATING TO PATENTS, TRADE MARKS, ETC.

By the U. S. Circuit Court.—Eastern District of Missouri.

MANUFACTURE OF ENAMELED IRON WARE.—ST. LOUIS STAMPING COMPANY *vs.* QUINBY *et al.*

1. Where the original patent described a process of enameling iron, the gist of which consisted in a certain preparation of the iron and the application of any well known enameling mixture, it was not at variance nor incompatible with the invention described to insert in the reissue of such patent a formula as to an enameling mixture which could work out the result.

2. If the specification contains such a description as will enable one skilled in the art to accomplish the desired result, it is sufficient without attempting to speculate as to the philosophy of its action.

3. The testimony of a witness as to prior use by him of the invention patented is rendered unreliable and incompetent by the circumstance that his employers, after having the benefit of his skill, sought the right to use the patented process as soon as they heard of it; and the further fact that the specimens produced were very different from those made under the patent.

4. Reissued Letters Patent No. 7,779, granted July 3, 1877, to F. G. & W. F. Niedringhaus, for improvement in the manufacture of enameled iron ware, are for the same invention as the original patent and valid.

The St. Louis Stamping Company is the assignee of reissued Letters Patent No. 7,779, granted to Frederick G. & William F. Niedringhaus, July 3, 1877, for "improvement in the manufacture of enameled iron ware."

The claims in the original patent are as follows:

1. The herein described process of enameling iron ware by oxidizing the iron during the process of the drying of the glaze, substantially as set forth.

That phraseology is not changed in the reissued patent.

The second claim is:

A new manufacture of enamel sheet iron ware, enameled substantially as described.

In the reissue the phraseology is:

As a new manufacture, mottled enameled sheet iron ware having the oxidized base fused with the surface glaze.

By the Commissioner of Patents.

TRADE MARK.—EX PARTE THE SAFETY POWDER COMPANY.

The term "safety," applied to powder, fuse lighters, and explosive caps, naturally suggests that these explosives may be used with comparative safety, and is therefore descriptive, and is not registrable as a trade mark.

TRADE MARK.—EX PARTE THOMPSON, DERBY & CO.

The word "swing," when applied to the socket of a scythe snath which moves on a pivot, each point describing the arc of a circle, and is made fast in different positions, indicates the peculiarity of the socket with sufficient precision to be descriptive, and cannot be registered as a trade mark.

WHEEL PLOWS.—LAPHAM *vs.* BETTENDORF.

Under Rules 7 and 57 the party to an interference who first files a completed application, including petition, specification, oath, drawings, model or specimens (when required), and first fee, is deemed to be the first inventor, in the absence of all proof to the contrary, and the testimony of the other parties is to be taken first.

LUBRICATOR PATENT OF NICHOLAS SEIBERT.—APPLICATION FOR REISSUE.

1. The machine for which Letters Patent No. 94,780 were granted September 14, 1869, to Nicholas Seibert, in the form in which he constructed it, necessarily involved the use of hydrostatic pressure as a force for the expulsion of the lubricant from the lubricating cylinder; but it was designed to be a steam lubricator, and the presence of hydrostatic pressure in the device, as an operative force, was not known or suspected by Seibert until after he had obtained his patent.

2. As he who, by a lucky accident, discovers a new art, is, under the law, as much entitled to a patent as he who, by an effort of genius, invents a new machine, however inferior in merit his work may be, so, also, is he who invents a machine which accomplishes its object entitled to a patent for it, whether he does or does not correctly understand the law or philosophy of its operation.

3. Seibert's lubricator, which was operated by hydrostatic as well as by steam pressure, was his invention, although he did not fully understand the law of its operation; and he is entitled to a patent for this particular machine, whether it operates as a steam lubricator, or as a hydrostatic lubricator, or as both combined.

By the Acting Commissioner of Patents.

MACHINE FOR CLEANING SILK THREAD.—TAYLOR *vs.* MARTIN.

When the evidence in an interference develops the fact that the contesting parties are not independent inventors, but jointly devised the invention, judgment of priority cannot be had in favor of either party, but the interference will be dissolved.

SHADE HOLDER FOR LAMPS.—MARSHALL *vs.* FISH *et al.*

1. Certain motions to strike out, not the final judgments of the Examiner of Interferences and the Examiner-in-Chief, but the views properly expressed by those tribunals in arriving at such judgments, denied.

2. The sole purpose of section 4,904 Revised Statutes being to enable the Commissioner to determine, by a proceeding known as an interference, whether he will grant a patent to an applicant, notwithstanding a patent for the same invention has been previously issued, or to which one of two or more contending applicants a patent shall issue, the question of priority between two or more patentees who may be parties to the proceeding need not and cannot be determined, after judgment therein has been rendered against the applicants who acquiesce in such judgment.

APPLICATION FOR REFRIGERATOR PATENT.—BATES.

1. A machine and a product, a process and a composition, an art and an article, and a "method and the means," each constitute distinct patentable subject matter, and but one of them can be the subject of a single claim.

2. Where the improvement made consists of an apparatus, it alone should be claimed, and not its functions, nor should the apparatus be claimed as "means" for accomplishing the result.

APPLICATION FOR A DESIGN PATENT FOR SPOON HANDLE.—BEATTIE.

More than one separate and independent design cannot be claimed in the same application; but, where the design is an entirety, a claim for the entire design, as well as claims for sub-combinations of the parts, is allowable.

The Mysterious in Boiler Explosions.

There is beyond question an element of mystery attending certain boiler explosions. At one time all explosions of boilers, save those which obviously resulted from shortness of water or extensive corrosion of plates, were regarded as mysterious and remarkable. Theories have been formed almost without number to account for their occurrence—in a word, to solve the mystery. The spheroidal theory of Boutigny d'Evreux may be cited as an example. When water is dropped on a hot plate it assumes the spheroidal condition, runs about in drops, and evaporates slowly. The drops are really not in contact with the plate at the time, each drop being enveloped in an atmosphere of its own vapor. When the plate cools the water touches it and flashes into steam. It was supposed that under certain circumstances water assumed the spheroidal condition in normal steam generators, and that a great development of steam ensued when the furnace plates cooled a little; so much steam being made thus in a few seconds that the boiler burst. This idea is now well known to be fallacious.

Another theory was that if a boiler was heated red hot and cold water pumped in it would infallibly explode; this is obviously the tail end of the speroidal theory. Inasmuch as the specific heat of iron is but one ninth that of water, in round numbers it follows that nine pounds of iron heated to about 1,500° must give up their heat to make one pound of steam; and it has never yet been shown how enough red hot iron could be present in a boiler to cause a development of steam with which the safety valve could not deal. Many experiments have been carried out to test the point, with negative results as far as explosions are concerned.

The electrical theory was broached. What this meant we never understood, nor did we ever meet any one who did. One gentleman promised to prevent all explosions from this cause by incasing every boiler in thin sheet copper. Another proposed to fit conducting wires to put boilers in communication with the earth. The notion that water was decomposed into oxygen and hydrogen, and subsequently recomposed with a terrible explosion, kept its ground for a long time. We believe we may say that no engineer possessing a moderate knowledge of chemistry holds such a theory now The inspecting engineers of the various boiler insurance and assurance companies were the first to place the whole subject on a sound footing. They showed as a result of their experience that boilers burst because they were too weak to withstand the strains brought on them by the internal pressure. They proved that in the vast majority of cases furrowing, and grooving, and corrosion in all their multifarious forms, were the agents operating to bring about boiler explosions, and they carried back such catastrophes from the regions of romance to those of everyday life. There is some reason, however, to fear that these gentlemen have gone a little too far; and that by assigning all boiler explosions to one cause they are doing harm and stopping inquiry into certain secrets of nature about which we do not know quite so much as is desirable.

That by far the larger number of explosions which occur every year in England are due to weakness of the boilers which give way, either congenital or acquired, we should be the last to dispute. But it is equally indisputable that events take place now and then which quite upset all conclusions based on the idea that explosions always take place because a boiler is too weak to withstand normal strains, and these said events apparently contradict much that sound scientific authorities teach. Thus, for example, although the entrance of cold water into a red hot boiler ought not to cause an explosion, yet there is one case at least on record in which, on a pail of cold water being poured suddenly into a red hot kitchen boiler, a most violent and disastrous explosion took place. The weight of metal engaged here was, however, very great as compared with that of the water. It is also shown that explosions have ensued when water was pumped into plain cylindrical externally fired boilers, which had been allowed to run short.

On the other hand, boilers patched and re-patched, and seemingly worthless, have by the hundred done their duty for years without a catastrophe, while boilers as well made as possible, and in excellent condition—nearly new in fact—have exploded with disastrous results. So long as furrowing and corrosion are present it is easy to account for the failure of a boiler. It is when explosions of strong boilers occur that inspectors are at fault, differences of opinion arise, and we become enveloped in an atmosphere of mystery out of which it is difficult to find the path which leads to certainty. Two notable examples of this have been recently recorded in our columns: one is the Coltness explosion, when six boilers out of ten flew away at once like a covey of birds; the other is the Kersley explosion, when one boiler out of eight burst, leaving the rest intact.

As regards the Coltness explosion, that, as is well known, has been explained by Mr. Fletcher on the theory that one boiler which exploded first had the steam pipe plugged up, and consequently gave way from a sheer accumulation of pressure. We cannot find that one tittle of definite evidence was adduced to show that any such plugging took place. Mr. Fletcher is, no doubt, satisfied on this point, but we are not. In fact his theory is based on pure assumption. But, granting that he was right, how are we to account for the explosion of the remaining five boilers? One explanation is that the boilers were bedded so close that they rested against each other, and that each boiler as it gave way staved in the side of the next one to it. To make this an intelligible cause of explosion, it must be assumed that the sudden reduction of pressure on the outrush of steam through the side of the broken boiler caused so large a portion of the contained water to flash into steam that the boiler flew into pieces before the steam so produced could escape. But it is well known that the Coltness boilers were strong enough to stand a pressure of 300 pounds on the square inch, and it is difficult, if not impossible, to see how steam of any pressure like this could be produced. Only as much water would be converted into steam as would suffice to restore the pressure in the boiler to something less than what it was before the rent took place. To assume anything else is also to assume that once the process of flashing is established it will go on regardless of the pressure set up. This is a very important assumption; nay, more, it is a complete begging of the question. If it can be shown conclusively that the stored-up energy in a boiler can all be expended in flashing water into steam, if flashing is once fairly set up, without any consideration for the accumulation of that pressure which is inimical to the operation of the flashing function, then we are face to face with a new physical law which would clear away much mystery, and set boiler explosions, like that at Coltness, in a totally new light. It is a notorious fact that a great many explosions take place just when an engine is started. If we may assume that the sudden reduction of pressure sets up flashing, and that the process is continued by, if we may use the words, its own *vis viva*, then it is easy to understand why a sudden reduction in pressure may cause an explosion; but until some definite statement of facts is available, we must hold this idea to be pure, little supported, theory, and nothing else. If we are asked, how, if we reject the theories of Mr. Fletcher and others, we explain the Coltness explosion, we reply that we cannot explain it, because there is not sufficient evidence available on which to base an opinion.

In the Kersley explosion we have a boiler, insured, carefully looked after, and apparently sound, going to pieces without having given warning in the way of leakage. Here again we find boiler inspectors dealing largely in pure assumption. Mr. Hiller, the engineer of the National Insurance Company, took it for granted that an elbow pipe was broken off and let the water run out. But there is not a scrap of evidence that a cast iron pipe was broken as supposed. Mr. Baldwin, another boiler inspecting engineer, holds that Mr. Hiller is quite wrong, and that the boiler burst because the plates had become weakened by age; that they had "lost their nature," to use a word well known among iron makers. But even Mr. Baldwin finds all the plates he tested so strong that the boiler should have withstood on the lowest calculation double the pressure at which it was worked. It is to be presumed that the inspecting engineers of boiler insurance companies are the greatest authorities in existence on all that pertains to the life and death of steam generators. When we find any one of these gentlemen unable to form any opinion concerning certain catastrophes, which is not flatly contradicted by a professional brother, it would be folly to deny that there are mysterious boiler explosions—that is to say, explosions which occur from some cause or causes unascertainable. That we shall always remain in our present ignorance is very improbable. But we venture to think that the solution of our difficulties will come, not from the boilermaker or the engineer, but from an elaborate process of physical research into the laws which govern the generation and evolution from heated liquids of their steams or vapors. Many suggestive phenomena have been recorded which might serve to direct an inquirer. For example, the behavior of water heated under oil is, as shown by Dr. Frost many years ago, very curious and suggestive. Again, water may have its boiling point altered by various conditions other than those of pressure. It is not too much to say that although the more prominent aspects of evaporation and ebullition have been carefully studied, a great deal remains to be learned concerning the real nature of processes about which men speak all the more glibly the less they really know.—*The Engineer.*

AMONG the novel applications of glass is the invention of Hamilton L. Bucknill, of England, who has recently patented in this country a railway sleeper made of cast glass.

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Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

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The Genuine Asbestos Liquid Paints are used on the finest and most important structures in this country, and are particularly adapted for first-class dwellings. H. W. Johns Manufacturing Company, 87 Maiden Lane, New York, sole manufacturers.

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The American Standard Gauge and Tool Works of Philadelphia has consolidated with the Betts Machine Company, of Wilmington, Del. Sandard gauges as well as heavy machine tools now in stock.

Magnets, Insulated Wire, etc. Catalogue free. Goodnow & Wightman, 176 Washington St., Boston, Mass.

Cooper Manufacturing Company, Mt. Vernon, Ohio, Manuf's of Stationary, Portable, and Traction Engines, Saw Mills, Grist Mills, Mill Machinery, etc. Engineers and Contractors. Circular free.

Inexhaustible Beds of Kaolin or Clay.—Wanted experienced pottery men to take an interest in the white, pink, and yellow kaolin beds. Digging and shipping on cars will cost 50 cents per ton. M. J. Dobschutz, Belleville, Ill., Agent.

The New Economizer, the only Agricultural Engine with return flue boiler in use. See adv. of Porter Mfg. Co., page 78.

Employment Wanted.—Tool Maker and Machinist. Can do the best of work. Had charge of men for the past five years. P. O. Box 891, Rome, N. Y.

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For Screw Cutting Engine Lathes of 14, 15, 18, and 22 in. Swing. Address Star Tool Co., Providence, R. I.

The Horton Lathe Chucks; prices reduced 30 per cent. Address The E. Horton & Son Co., Windsor Locks, Conn.

Lincoln's Milling Machines; 17 and 20 in. Screw Lathes. Phœnix Iron Works, Hartford, Conn.

A Cupola works best with forced blast from a Baker Blower. Wilbraham Bros., 2,318 Frankford Ave., Phila.

Presses, Dies, and Tools for working Sheet Metal, etc. Fruit & other can tools. Bliss & Williams, B'klyn, N. Y.

Linen Hose.—Sizes: 1½ in., 20c.; 2 in., 25c; 2½ in., 29c. per foot, subject to large discount. For price lists of all sizes, also rubber lined linen hose, address Eureka Fire Hose Company, No. 13 Barclay St., New York.

Workshop Receipts for Manufacturers and Mechanics. Illustrated. $2.00 E. & F. N. Spon, 446 Broome St., N. Y.

Nickel Plating.—A white deposit guaranteed by using our material. Condit, Hanson & Van Winkle, Newark, N.J.

The Lathes, Planers, Drills, and other Tools, new and second-hand, of the Wood & Light Machine Company, Worcester, are being sold out very low by the George Place Machinery Agency, 121 Chambers St., New York.

Hydraulic Presses and Jacks, new and second hand. Lathes and Machinery for Polishing and Buffing Metals. E. Lyon & Co., 470 Grand St., N. Y.

Walrus Leather, Solid Walrus Wheels; Wood Wheels covered with walrus leather for polishing. Greene Tweed & Co., 18 Park Place, New York.

Bradley's cushioned helve hammers. See illus. ad. p. 126.

Excelsior Steel Tube Cleaner, Schuylkill Falls, Phila., Pa.

Vertical Engines. F.C. & A.E. Rowland, New Haven, Ct.

Band Saws a specialty. F. H. Clement, Rochester, N.Y.

Diamond Drills, J. Dickinson, 64 Nassau St., N. Y.

Sheet Metal Presses, Ferracute Co., Bridgeton, N. J.

Vertical Burr Mill. C. K. Bullock, Phila., Pa.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Noise-Quieting Nozzles for Locomotives and Steamboats. 50 different varieties, adapted to every class of engine. T. Shaw, 915 Ridge Avenue, Philadelphia, Pa.

Stave, Barrel, Keg, and Hogshead Machinery a specialty, by E. & B. Holmes, Buffalo, N. Y.

Solid Emery Vulcanite Wheels—The Solid Original Emery Wheel—other kinds imitations and inferior. Caution.—Our name is stamped in full on all our best Standard Belting, Packing, and Hose. Buy that only. The best is the cheapest. New York Belting and Packing Company, 37 and 38 Park Row, N. Y.

Ornamental Penman's Pocketbook of Alphabets. 32 plates. 20c. Mail free. E. & F. N. Spon, 446 Broome St., N. Y.

For Sale.—United States Patent on Diagonal Churn. Working model on exhibition. Address "Techniker," Room 5, *Staats Zeitung* Building, New York.

New 8½ foot Boring and Turning Mill for sale cheap. A first class tool. Hilles & Jones, Wilmington, Del.

Manufacturers of Metal Pocket Match Boxes please address Harrison Brothers & Co., Philadelphia, who wish to contract for quantity.

Elevators, Freight and Passenger, Shafting, Pulleys, and Hangers. L. S. Graves & Son, Rochester, N. Y.

Holly System of Water Supply and Fire Protection for Cities and Villages. See advertisement in SCIENTIFIC AMERICAN of this week.

Lathes, Planers, and Drills, with modern improvements. The Pratt & Whitney Co., Hartford, Conn.

Deoxidized Bronze. Patent for machine and engine journals. Philadelphia Smelting Co., Phila., Pa.

Having enlarged our capacity to 96 crucibles 100 lb. each, we are prepared to make castings of 4 tons weight Pittsburgh Steel Casting Co., Pittsburgh, Pa.

Hand Fire Engines, Lift and Force Pumps, for fire and all other purposes. Address Rumsey & Co., Seneca Falls, N.Y., and 93 Liberty St., N. Y. city, U.S.A.

For Shafts, Pulleys, or Hangers, call and see stock kept at 79 Liberty St., N. Y. Wm. Sellers & Co

Wm. Sellers & Co., Phila., have introduced a new Injector, worked by a single motion of a lever.

Steam and Gas Fitters' Tools a specialty. Send for circulars. D. Saunders' Sons, Yonkers, N. Y.

NEW BOOKS AND PUBLICATIONS.

AROUND THE WORLD WITH GENERAL GRANT. By John Russell Young. New York: Subscription Book Department of the American News Company. Published in 20 parts. Each 68 pp. 8vo. Illustrated. 50 cents.

Parts I. and II. of this splendid record of travel cover the experiences of General Grant in England. No traveler was ever received with so much distinction by the leaders of thought and action the world over, or ever saw, under more favorable conditions, the best that the civilized world has to offer. The narrative of his journey is cleverly told and lavishly illustrated; and, so far as published, amply fulfills the promise of the publishers to make it the finest record yet printed of a tour of the world. With such a wealth of superior material to choose from Mr. Young could scarcely fail to make an interesting volume; his skill and experience as a journalist left no doubt of his making good use of his opportunities. It is not likely that any other writer will ever have a story to tell involving so many brilliant scenes or containing so much to gratify American pride.

BIRDS OF THE COLORADO VALLEY. By Elliott Coues. Part First, Passeres to Laniidæ. Washington: Government Printing Office.

It is rare that a book, more especially an official document, is so much more than it professes to be as this admirable report of Dr. Coues. The value of the bibliographical appendix it is impossible to overestimate. The whole subject of the bibliography of North American ornithology and of the synonomy of North American birds has been worked up anew from the very beginning, every point being verified by personal investigation. It is by far the best work ever done in this department.

THE ART INTERCHANGE. Volume II. January to June, 1879. New York: The Art Interchange Publishing Company. Price $1.50 a year.

This unpretending but sensible and admirably edited household journal deserves the cordial support of every one who cares for the promotion of the polite arts. It is not only an art newspaper of a fine and discriminating character, but a periodical instruction book giving theoretical and practical lessons in art methods, which will be found of value in every refined household. It is published fortnightly, and each number has twelve pages, with an occasional illustrated supplement.

ORGANIC CHEMISTRY, PRACTICAL AND THEORETICAL. By Hugh Clements. London: Blackie & Son, 16mo, cl., pp. 283.

Specially designed for the students in the Science and Art Department, South Kensington. The descriptive portion appeared originally in a series of articles in the *English Mechanic*, to which has been added some fifty pages on the identification of organic substances, a short chapter on fixed and essential oils, a brief description of apparatus used in this department of chemistry, a list of practical questions and exercises, and eighty or more pages of papers set in organic chemistry at the Kensington examinations (with answers) for the ten years ending 1878.

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them.

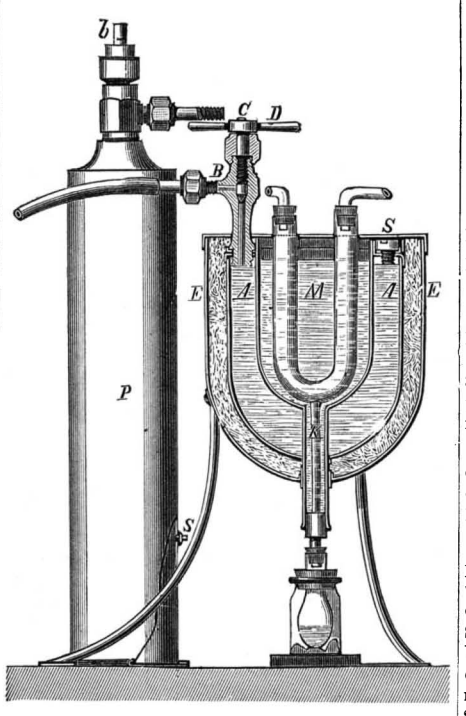
Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) S. S. H. asks: 1. What effect would the explosion of one pound of dynamite, 40 fathoms beneath the surface, have upon the larger fish in the immediate neighborhood? A. Those within the immediate vicinity of the explosion would be killed through the rupture of the air bladder and intestines; they would sink at once to the bottom. Those at a distance would be simply stunned, and would rise to the surface after a time. 2. If the effect is destructive, what would be the probable diameter of the circle of death? A. Perhaps within a radius of 50 yards. 3. Measuring from the surface, to what depth would the concussion be sensibly felt? A. The shock of the explosion would be felt most severely downwards—it is difficult to estimate. The disturbance would reach the surface, but the concussion there would be comparatively slight. 4. Do fish caught in this way become unfit for food; if so, in what way? A. No.

(2) D. H. H. writes: 1. I have been getting up a collection of entomological specimens for the past 3 or 4 years, and I have found that my specimens are eaten by a small grub which spoils a great many of them. I think they must generate in the specimens, as some of them are not exposed to the air. Will you please inform me what I can put on the insect that will prevent these moths hatching and not injure the specimen? Would corrosive sublimate do to paint them with? A. Impregnate the specimens with a solution of arsenious acid in dilute alcohol. See p. 11 (40), volume 38, SCIENTIFIC AMERICAN. 2. Will equal parts of alcohol and water preserve zoological specimens as well as pure alcohol? A. No. 3. Will you please inform me also what is the latest illustrated work published on American insects and reptiles suitable to classify and study up entomological and zoological specimens? A. Consult Packard's "Guide to the Study of Insects," Westwood's "Thesaurus Entomologicus Oxoniensis," Nicholson's Zoology, and Owen's "Vertebrate Animals."

(3) G. M. asks how methyl chloride can be used in the production of ice. A. Methyl chloride, which is used in the manufacture of green and violet aniline colors, was employed for this purpose some years since by Raoul Pictet, and lately Mr. Camille Vincent, of Paris, has used it to produce very low temperature. If compressed methyl chloride is liberated from this over-pressure it will begin to boil, and the temperature will fall to −8° Fah. This boiling will then stop, and the fluid methyl chloride will remain quiet without evaporating any further. By means of an air pump the temperature can be reduced to −67°. The small machine that Mr. Vincent uses for this purpose consists of a double walled copper vessel, between which two walls the methyl chloride enters at A. The space, M, contains some non-congealable liquid—alcohol, for instance. The space, E, is filled with some non-conductor of heat, as mineral



wax, etc. B is a stopcock which is opened and closed by turning D. P is a wrought iron receptacle containing the fluid methyl chloride. In order to conduct the methyl chloride into A, the side opening of the receptacle is connected with the rubber hose that is attached to B, the receptacle is raised and its stopcock is opened. That part of the methyl chloride that evaporates escapes through the opening, S. As soon as the temperature has fallen to −8° (the boiling point of methyl chloride), the opening, S, is closed. If it is desired to lower the temperature to −67°, an air pump must be attached to B. In this way a quart of alcohol can be kept at a temperature of −67° for several hours.

(4) U. R. N. G. writes: I have about $5 gold (pure) dissolved in hydrochloric acid; after acid is dried on fire, the gold is redissolved in solution of bichromate potassium. Do you think it is ready for gilding in electrotype battery? My battery is bichromate potassium and sulphuric acid for carbon, and weak sulphuric acid for zinc. The matter for gilding is hung on the zinc by a copper wire, and the gold is hung on the carbon by a copper wire. Will that do? If not, how is that done? A. Purify the gold by fusing it with 10 parts of borax glass in a black-lead or French clay crucible; dissolve it by aid of heat in a mixture of 3 parts hydrochloric and 1 part nitric acids, and evaporate the solution cautiously over a water bath nearly to dryness. Proceed as directed under head of "Electro Gilding," p. 2,540, No. 160, SCIENTIFIC AMERICAN SUPPLEMENT. 2. I have a big gutta percha dish, one corner of which is broken; can you tell me how I can repair it? A. Melt together equal parts of pitch and gutta percha, and add ¼ part of powdered shellac. This should be well stirred together. Use hot, and clamp the parts well together until the cement has hardened. 3. How are electrotypes taken from the gelatine mould? A. It is necessary to take a plaster cast of the gelatine mould. From this a positive cast can readily be obtained.

(5) F. N. L. asks how the bright gold and silver lettering is done on glass. A. The size is prepared by dissolving one ounce isinglass in just enough water to cover it; when dissolved add a pint of rectified wine spirit and make up to a quart with water. Give the clean glass a flowing coat of this, and carefully lay on the leaf, which will then readily adhere to the glass. Let it remain 24 hours to dry. The design or letter is drawn on paper, and the lines pricked with needle holes. Place this against the gilded surface and dust it thoroughly with powdered whiting. When the paper is removed there will remain a correct copy of the design or letter on the gold. Now fill up the outline with oil gold size in which has been ground some orange chrome, thinned somewhat with boiled oil and turpentine. When this has thoroughly dried wash off the surplus gold with water and a piece of cotton wool. Silvering may be done with the leaf, but it is better to use a dry amalgam. See p. 315, Spon's Workshop Receipts.

(6) J. D. M. asks how sperm oil can be divested of its gum and prepared for use on the sewing machine and other delicate machinery. A. Allow the oil to remain in contact with a quantity of lead turnings or clippings for several weeks (usually six weeks is required), then decant and strain through linen or a sand filter. See p. 1670, No. 105, SCIENTIFIC AMERICAN SUPPLEMENT.

(7) F. C. E. asks (1) how to bore a 3x4 inch cylinder for steam engine. A. You can bore it in an ordinary slide lathe, with boring bar and cutter. 2. How to make a permanent deposit of bright silver in desired places which cannot be reached by the hand, on the inner surface of bottles. A. Silver nitrate, 1 ounce; distilled water, 1 pint; strong aqua ammonia, *q. s.*, added gradually to first precipitate, and then redissolve the silver; honey, ¼ ounce. Pour this solution into the bottles, etc., immerse them in water and boil for 10 to 30 minutes, or until properly coated. See article "Silvering Glass," No. 105, SCIENTIFIC AMERICAN SUPPLEMENT. 3. Do most scientists of the present day, who have looked into the subject, believe in phrenology? A. No.

(8) S. E. writes: 1. I wish to turn a block, composed of a number of different kinds of wood; what is best to glue them with? I also wish to glue very thin strips of wood to linen; what is the best glue for the purpose? A. A fine animal glue is as good as anything for these purposes. 2. Where can I get an automatic tide register, and about what would one cost? A. Insert an advertisement in "Business and Personal" column. 3. How many people have obtained American patents? A. See the numbers in patent list on another page.

(9) H. L. B. asks: What size of steam pump would be required to force water through a 3 inch main a distance of 3,000 feet, with 50 feet elevation at end? A. You can use any size of pump you please; it must be determined by the quantity of water you wish to lift in a given time.

(10) H. M. H. asks: 1. What pressure of steam will a boiler stand made like the one described in SUPPLEMENT, No. 182, page 2891? A. If well put together, 150 lbs. per square inch. 2. Where should the water stand in it? A. One to two inches below top of lower flasks

(11) W. M. asks: 1. Will a boiler of 20 inches diameter, 20 inches high, ¼ inch iron, hold 350 lb. of steam to the square inch? A. Make it at least 5-16 inch thick. 2. How thick should the cylinder be, 3½ inch bore, by 6 inch stroke, to make 400 revolutions per minute, boiler pressure 300 lb.? A. ½ inch when finished.

(12) C. J. B. asks: What is the greatest depth in which any submarine diver has successfully operated? A. We think about 120 feet, at a wreck on Lake Erie.

(13) W. G. R. asks (1) how to make a preparation to dip packages in to give them a coating that will keep them waterproof and airtight, packages covered with brown paper. A. You may try the following: Shellac, 4 parts; borax, 1 part; water, *q. s.*, to form on boiling a very thin sirup. If required to dry very quickly, use hot. Or use a solution of shellac in wood naphtha containing a small quantity of boiled oil. 2. What will make a good cheap washing crystal? How is bluing put in washing crystal, and what kind of blue is used? A. "Washing crystal" is common commercial carbonate of soda, subcarbonate of soda. The bluing is either ultramarine or aniline blue (BB), added during the crystallization. 3. Can you get me a compound analyzed of a vegetable kind and tell me what it contains, and what would be your charge? A. Yes; the cost depends upon the nature of the compound.

(14) W. S. J. asks: 1. Which is the best deep sea sounding apparatus in use? A. That used by the United States Coast Survey. 2. What are its defects? A. This is probably as near perfect as any in use.

(15) W. asks: What acid can be used (if any) in making a monogram type upon copper, to eat away the surplus metal, leaving the letters stand out in relief, and the surface smooth? Please describe the process or give some other good method. A. Use nitric acid diluted with about 3 volumes of water. Cover the portions to remain untouched with paraffine. The sand blast may be advantageously used instead of acid in some cases.

(16) Our correspondent C. N. writes: Is it known what is the actual difference in the amount of fuel required to run a stationary boiler (doing substantially the same work) in winter as against the summer season, caused by the difference in temperature alone? Perhaps some of your readers can give the amount of fuel that was required to run a boiler that was exposed to the weather, for each of the twelve months, doing comparatively the same service. The result of a twelve months' performance of a small portable engine and boiler, used for sawing wood, would be a fair test, as the exposure of it to atmospheric changes would be unquestionable. [Perhaps some of our readers will be able to furnish the information desired by C. N.]

(17) F. B. asks: 1. In the dynamo-electric machine described in SUPPLEMENT 161, can the cores of the electro-magnets be cast of common cast iron, or would that be too hard? A. Soft cast iron will do. 2. How long ought a bichromate battery work without attention? A. It depends on how much is required of it. Ordinarily two weeks. 3. What is vulcanite? A. Hard rubber.

(18) A. M. W. asks: What metallic or non-metallic substance, heated to a red or white heat, will retain that degree of heat longest after it has been removed from within the flame, and which with an occasional use each day will probably sustain the injurious effects of the flame longest without requiring to be replaced? A. Common fire brick will probably answer your purpose best.

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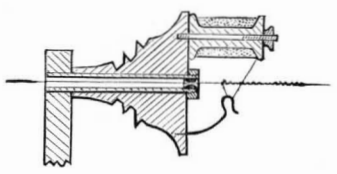
(19) R. K. writes: 1. I am about building a screw propeller launch, 25 feet long and 5 feet beam, to be run by an engine with cylinder 2x5 inches. About how many miles an hour, with 150 lb. of steam on, would she run, with a 3-16 inch steel boiler, size 20x35 inches? A. If boat has good model, probably 4½ or 5 miles per hour. 2. Where and at what price could I get a complete description of the electro-magnetic engine? A. The back numbers of the SCIENTIFIC AMERICAN and SUPPLEMENT contain all of the recent information on this subject. 3. What is the cost of running a magnetic engine as compared with a steam engine of the same power? A. The cost of running a magnetic engine is about 50 times as great as steam. 4. About what is the price of a six horse power magnetic engine? A. We think there are no engines in market of that size.

(20) D. L. M. writes: In a fire engine at work, throwing water through 200 feet of hose with an inch nozzle, where is the greatest pressure of water: as it leaves the engine, or at the inch hole at the end of the nozzle? A. At the pump.

(21) J. F.—A simple device for covering wire is shown in the annexed engraving. A ⅜ tube



having a smooth exterior is screwed into a wooden standard, and supports a wooden pulley that carries a spool containing the silk or cotton with which the wire is wrapped. The thread passes from the spool through the small wire guide hook, thence to the wire to be covered, which is drawn slowly through the tube as the pulley revolves. The pulley may be turned by connection with a lathe, or it may be driven by a belt from the driving wheel of a sewing machine. The wire being covered may be drawn through the machine by hand, or a reel may be easily attached and arranged to take motion from the pulley.

(22) W. P. asks: 1. If a sulky or gig is being run around a course or a circle, with a horse hitched to the same, which way will it upset, or which way is it liable to upset: towards the center of ring or the outside? A. Toward the outside. 2. If a locomotive is running around a sharp curve, do not the driving wheels on the inside of curve have to slip on the rail? A. One or both wheels must slip. 3. What will I put on common paper to make impression paper for transferring patterns on wood? A. See p. 283 (23), Vol. 40, of SCIENTIFIC AMERICAN.

(23) F. R. R. writes: 1. In the SCIENTIFIC AMERICAN of August 9, page 91, communication (10), H. W. F. describes a cheap battery. I wish to ask: 1. What is the battery fluid? A. 2 parts of bichromate of potash dissolved in 20 parts of hot water. When cold add 1 part of sulphuric acid. 2. Where can the gas carbon be obtained, and how prepared? A. It is obtained from the retorts of gas works. It may be chipped or sawed into shape, but it is usually pulverized, mixed with soft coal dust, and calcined in iron moulds. Plates of this kind may be had from any dealer in electrical supplies. 3. Can it be made from lampblack? A. No. 4. Is the amalgamated zinc the same as that commonly used in plumbing, roofing, etc.? A. No, it is not as pure as it should be; however, it may answer your purpose.

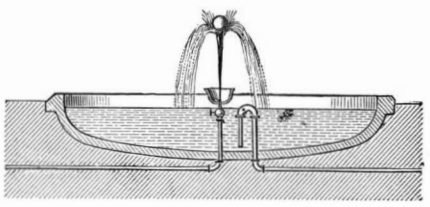
(24) R. W. D. asks: 1. What chemical should I use to saturate paper to be used on a chemical telegraph? A. Nitrate ammonia, 2 lb.; muriate ammonia, 2 lb.; ferri-cyan. potassium, 1 ounce; water, 1 gallon. 2. Also, is there sufficient resistance in above paper to keep current from passing through it? A. No; the current must pass to make the mark. 3. How can I gild iron to resemble brass, inexpensively? A. Clean the iron by scouring, and rub it with sawdust slightly moistened with a dilute acid solution of copper sulphate. Rinse, dry, and lacquer if necessary. 4. What is the resistance of one mile of No. 14 galvanized iron wire? A. 51 ohms.

(25) C. C. H. asks how to arrange connections on a telephonic line having three telephones and using electric alarm bells as calls. A. Use single stroke bells on a closed circuit. Have a switch to throw the bell out, and the telephone into the circuit after the alarm.

(26) C. A., Jr., asks: 1. Is there any particular rule for cutting threads with simple or compound gearing, given only the number of threads in feed screw; if so, what are they? A. $\frac{T}{t}\frac{S}{t'}I = N$; $\frac{t}{I}\frac{t'}{T} = S$. T representing the number of teeth in traverse screw wheel; S number in stud wheel gearing in mandrel; t number in wheel upon mandrel, and t' number in gearing upon stud pinion, gearing in T; I number of threads per inch upon traverse screw; N number to be cut. 2. We have for one engine two horizontal boilers and one steam drum. What is the gain by having a safety valve on each boiler and one on the drum? Why couldn't we do with only the one on the steam drum? A. If there are shut off valves to your boilers, you should, for safety, have a safety valve to each boiler; none is necessary to the drum if the communication to the boilers is free. 3. How do you find the horse power of an engine? A. See p. 267 (4), Vol. 40, SCIENTIFIC AMERICAN.

(27) A. K. asks: What is the greatest altitude yet reached by a railroad? A. Some railway memoranda lately published in Germany give the highest points yet reached by existing railways passing over mountain ranges or through mountain passes. The Apennine line reaches a height of 2,024 feet; the Black Forest line, 2,789 feet; the Semmering, 2,920 feet; the Caucasian line, 3,198 feet; the St. Gothard (tunnel), 3,786 feet; the Brenner, 4,475 feet; Mont Cenis (tunnel), 4,390 feet; the North Pacific, 5,420 feet; the Central Pacific, 7,021 feet; the Union Pacific, 8,573 feet; while a railway over the Andes climbs to 15,646 feet.

(28) J. W. W. writes: I inclose you section of small fountain reservoir, with (I think) a novel automatic siphon. We built two small fountains in a portion of the yard where the inmates have access to them, and fearing the overflow pipe would be tampered with, I put in a siphon overflow as shown in the cut.



It answers two purposes, acting as a positive overflow, and, when it is desirable to clean the basin, the entire body of water can be siphoned out by putting a small wood plug in the air hole at the bend. This device has been working about two months under a variable pressure of water, and the water line never gets above the return elbow, or below the bottom of air hole.

(29) E. H. M. asks how to obtain crystals of bismuth. A. This is effected most easily by melting two to four pounds of the metal in a hemispherical iron ladle, allowing it to cool slowly until a crust is formed on the surface, then breaking this with a wire and pouring out quickly the still fluid metal from within. This yields, if not always large crystals, at least faces, from which project the corners of numberless cubes. Fine large crystals, with beautiful stair-like arrangement, can be obtained only by making the bismuth chemically pure, which is a tedious operation.

(30) P. H. V. asks whether one billion represents one thousand millions or one hundred millions; please put the figures the way they should be written to represent one billion. A. 1,000,000,000. French method correct for this country.

(31) C. M. D. writes: To-day when the wind was blowing pretty briskly, I felt, as I sat at my window in sixth story, a tingling sensation in my forehead, just above and between my eyes, such as would be caused by application of one of poles of an electric battery to that part. Can you account for it? Could there have been a current of electricity in the air? The wind was blowing from Western Union building and across hundreds of wires toward me. I have some curiosity to find out the cause of the sensation, which was not unpleasant, and which was not neuralgic or painful in the least. A. We think the sensation experienced by you could hardly have been produced by electricity. It was probably due to the cooling of the forehead by the rapid evaporation of perspiration; however this is a subject that will bear investigation.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

A. S. C.—It is a titaniferous iron ore; it cannot be smelted to advantage.—G. F.—A. The pyrrhotine is not nickeliferous and cannot be profitably worked for the small amount of gold which it carries. B. is not free milling—it contains too much galena, though not enough for smelting. It must be roasted.—H. W. McC. —Impure kaolin, or porcelain clay, if properly washed may be useful in the manufacture of cheap white ware, etc.—N. G. F. B.—They are tourmaline, muscovite in quartzite, and biotite.—W. M. H.—No. 1. Missing. No. 2 contains 80 per cent of lead. No. 3 is also rich in lead, carrying about 5 ounces of silver per ton. It may be smelted in the simple blast furnace; few smelters desilverize their lead. It is sold as base bullion on assay.—J. E. B.—No. 1 is plumbago; if properly washed and purified, worth about 7 cents per lb.—B. F. J.—It is a bituminous shale; it will yield oil, gas, and tar upon distillation. No. 2 is a jaspery hematite. No. 3 is an impure limonite. No. 4 is a silicious limestone, and if properly burned will doubtless yield a good hydraulic cement.—F. J. R.—No. 1 is chalcopyrite, a copper ore. No. 2, the gray part is fibrous zeolite. No. 3 is hornblende and quartz. No. 4, fibrous amphibole. No. 5 is leucopyrite or arsenide of iron.—S. A. S.—The vine sent is the climbing wild hemp (*mikania scandens*), common in the middle Southern States.—J. E. T.—The box contains fragments of semi decomposed orthoclase and sandstone, serpentine rock and impure manganite, or ferromanganese.—J. M.—It is nodular iron pyrites, iron sulphide.

COMMUNICATIONS RECEIVED.

On the Cause of Boiler Explosions. By A. J. P.
On the Wheel Question. By J. K.
On the Movement of Light in Space. By A. S.
On Easily made Slide Valve. By F. O.
On Diet. By T. B. McC.
On the New Optical Delusion. By C. L., H. W. F. A. O., R. H. B.
On Safety Appliance for Boilers. By P. C. F.
On Optical Delusion. By G. A. S.
On Diffusion. By S. R. S.

[OFFICIAL.]

INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

July 15, 1879,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

Agricultural implement, E. Schlag	217,491
Aluminous cake, manufacture of, T. S. Harrison	217,460
Ammunition case, O. K. Buckhout	217,508
Animaltrap, W. N. Fort	217,602
Awl handle, S. F. Merritt	217,668
Axle and axle box, carriage, B. N. Shelley	217,492
Barrel stand, L. D. West	217,563
Basket, E. D. Ballou	217,572
Bath tub, F. W. Ningard	217,635
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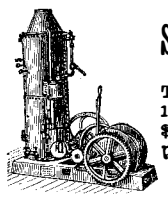

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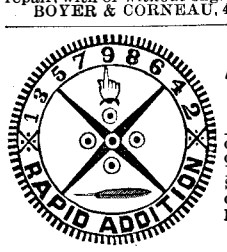

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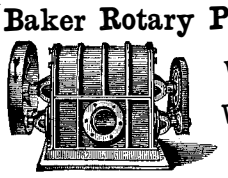

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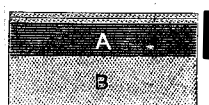

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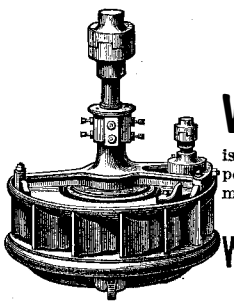

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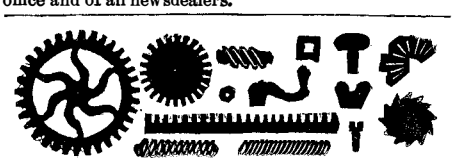

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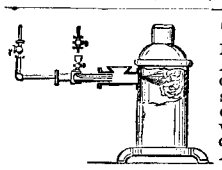

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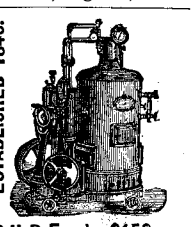

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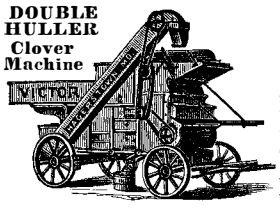

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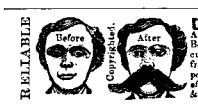

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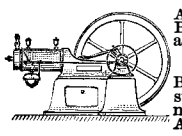

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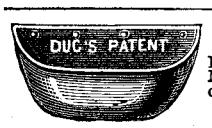

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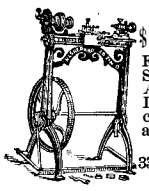

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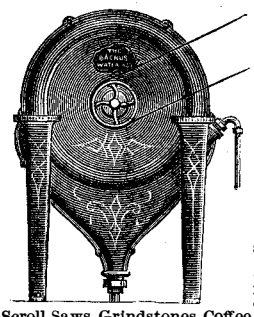

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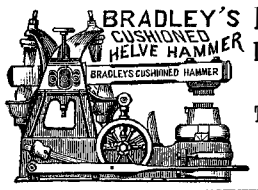

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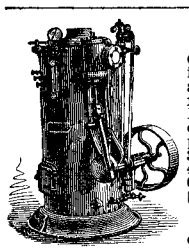

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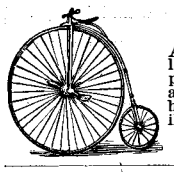

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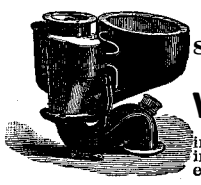

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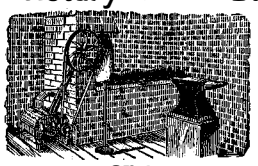

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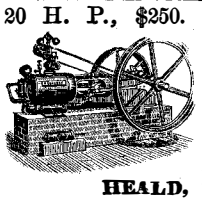

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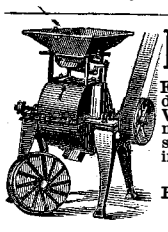

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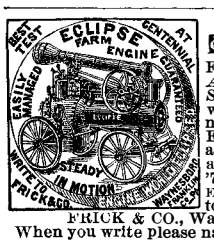

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